

# **AMD** **AMD M690T/E Databook**

**Technical Reference Manual  
Rev. 3.06**

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Please note that in this databook, references to "DVI" and "HDMI" refer to the capability of the TMDS interface, multiplexed on the PCI Express<sup>®</sup> external graphics interface, to enable DVI or HDMI through passive enabling circuitries. Any statement in this databook on any DVI or HDMI-related functionality must be understood in that context.

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# Chapter 1

## Overview

### 1.1 Introducing the M690T

The M690T is a seventh generation Integrated Graphics Processor (IGP) that integrates a DirectX® 9.0 compliant 2D/3D graphics core and a system controller in a single chip. It supports the AMD Athlon™ 64, Athlon 64 FX, Athlon 64 X2, AMD Sempron™, and AMD Turion™ 64 processors, including both AM2 and S1 socket CPUs. All CPUs are supported on both high performance and value platforms.

The M690T integrates an ATI Radeon™ X1200 graphics engine, dual display, a TV encoder, an LVDS interface, an integrated TMDS controller, and Northbridge functionality in a single BGA package. This high level of integration and scalability enables manufacturers to offer enthusiast level capabilities and performance while minimizing board space and system cost.

#### Robust and Flexible Core Logic Features

The M690T combines graphics and system logic functions in a single chip using a 21mm-body FCBGA package, reducing overall solution area. For optimal system and graphics performance, the M690T supports a high speed HyperTransport™ interface to the AMD processor, running at a data rate of up to 2GT/s and supporting the new generation of AM2 and S1 socket processors. The M690T is ideally suited to 64-bit operating systems, and supports platform configurations with greater than 4GB of system memory. The rich PCI Express® expansion capabilities of M690T, including support for PCI Express external graphics and up to four other PCI Express peripherals, are complemented by the advanced I/O features of AMD's SB600 Southbridge.

#### Best for Windows Vista™

The M690T delivers the best Windows Vista™ experience of any integrated graphics and core logic product for the AMD platform. It incorporates an ATI Radeon™ X700-based graphics core, which provides the 3D rendering power needed to generate the Windows Vista desktop even under the most demanding circumstances. In addition, dedicated hardware acceleration is provided for key new Windows Vista features such as ClearType®. This ATI Radeon X700-based graphics technology also enables great 3D application performance through SmartShader™ HD, SmoothVision™ HD, and 3Dc™ technologies.

#### Leading Multimedia Capabilities

The M690T incorporates the innovative ATI Avivo™\* display architecture, providing users with visual quality which is second to none. Advanced scaling and color correction capabilities, along with increased precision through the entire display pipeline, ensure an optimal image on CRT monitors, LCD panels, and any other display devices. A new TV encoder, based on designs used in AMD's Xilleon™ products, provides unequalled quality, and a TMDS interface, configurable to support DVI/HDMI and HDCP, allows compatibility with even the most modern high definition televisions without the additional cost of external components.

**\*Note:** ATI Avivo™ is a technology platform that includes a broad set of capabilities offered by certain ATI Radeon products. Full enablement of some ATI Avivo™ capabilities may require complementary products.

#### Low Power Consumption and Industry Leading Power Management

The M690T is manufactured using a power efficient 80nm technology, and it supports a whole range of industry standards and all new proprietary power management features. In addition to comprehensive support for the ACPI specification and AMD features such as AMD PowerNow!™, the ATI PowerPlay™ technology (enhanced with new adaptive frame buffer compression and ATI PowerShift™ features) minimizes the M690T's power consumption by adjusting graphics core performance and core voltage to the task and usage environment.

#### Software Compatibility

The graphics driver for the M690T is fully compatible with all other ATI Radeon class graphics controllers from AMD. A single driver can support multiple graphics configurations across AMD's product lines, including the ATI Radeon family

and the AMD chipset family. In addition, this driver compatibility allows the M690T to benefit immediately from AMD's software optimization and from the advanced Windows® XP and Windows Vista support available in the ATI Radeon family drivers.

**Note:** In some reference documents, the M690T is referred to by its code name "RS690T," which signifies the same device.

## 1.2 M690E

The M690T and M690E are the same device with respect to their form, fit, and functionally, except for the differences described in [Appendix B, "AMD."](#) All information in this databook, unless superseded by the information given in [Appendix B](#), is applicable to the M690E.

## 1.3 M690T Features

### 1.3.1 CPU HyperTransport™ Interface

- Supports the mobile and desktop Athlon 64/Athlon 64 FX/Athlon X2/AMD Sempron/AMD Turion 64 processors, including both AM2 and S1 socket CPUs.
- Supports 200, 400, 600, 800, and 1000MHz HyperTransport (HT) interface speeds.
- Supports LDTSTP interface, CPU throttling, and stutter mode.

### 1.3.2 Memory Interface

- Supports an optional dedicated local frame buffer (side-port) of up to 128MB through a 16-bit interface.
- New highly flexible memory architecture allows asymmetric side-port and shared system memory frame buffer sizes.
- New dynamic memory allocation scheme improves performance and reduces power simultaneously.
- Support for DDR2 system memories up to DDR2-800, with a maximum memory clock speed of 400MHz. Memory clock is independent of any other clock source and can therefore be set to any frequency equal to or less than 400MHz (DDR2-800), allowing the use of lower speed side-port memories.
- Support for 16Mx16, 32Mx8, 32Mx16, 64Mx8, and 64Mx16 memory devices.
- Asynchronous HyperTransport and memory controller interface speeds.
- Supports DDR SDRAM self refresh mechanism.
- Supports dynamic CKE and ODT for power conservation.

### 1.3.3 ATI HyperMemory™ Technology

- Supports ATI HyperMemory™\* technology.

\* **Note:** The amount of HyperMemory available includes both dedicated and shared memory and is determined by various factors. For details, please refer to the product advisory numbered PA\_IGPGenC5, available on AMD's OEM Resource Center or from you AMD CSS representative.

### 1.3.4 PCI Express® Interface

- Compliant with the PCI Express (PCI-E) 1.1a Specification.
- Highly flexible PCI-E implementation to suit a variety of platform needs.
- A x8 graphics interface, configurable to any of the following modes of support:
  - An external graphics device utilizing all 8 lanes (see [section 1.3.11 "DVI/HDMI" on page 1-5](#) for details).
  - A TMDS interface, enabling DVI/HDMI.
  - A single x1, x2, x4, or x8 general purpose PCI-E link.
- Supports programmable lane reversal for the graphics link to ease motherboard layout when the end device does not support lane reversal.

- A four-port, x4 PCI Express general purpose interface, configurable to one of the following modes of support:
  - Four x1 links.
  - Two x2 links.
  - One x2 and two x1 links.
  - One x4 link.

### 1.3.5 A-Link Express II Interface

- One x4 A-Link Express II interface (PCI Express 1.1 compliant) for connection to an AMD Southbridge, providing more bandwidth than the older A-Link Express interface.

### 1.3.6 2D Acceleration Features

- Highly-optimized 128-bit engine, capable of processing multiple pixels per clock.
- Hardware acceleration of Bitblt, Line Draw, Polygon / Rectangle Fill, Bit Masking, Monochrome Expansion, Panning/Scrolling, Scissoring, and full ROP support (including ROP3).
- Optimized handling of fonts and text using AMD proprietary techniques.
- Hardware acceleration for ClearType font rendering.
- Game acceleration including support for Microsoft's DirectDraw<sup>®</sup>: Double Buffering, Virtual Sprites, Transparent Blit, and Masked Blit.
- Acceleration in 1/8/15/16/32 bpp modes:
  - ClearType mode for 1bpp
  - Pseudocolor mode for 8bpp
  - ARGB1555 and RGB565 modes for 16bpp
  - ARGB8888 mode for 32bpp
- Significant increase in the High-End Graphics WinBench<sup>®</sup> score due to capability for C18 color expansion.
- Setup of 2D polygons and lines.
- Support for GDI extensions in Windows XP and Windows Vista: Alpha BLT, Transparent BLT, Gradient Fill.
- Hardware cursor (up to 64x64x32bpp), with alpha channel for direct support of Windows XP and Windows Vista alpha cursor.

### 1.3.7 3D Acceleration Features

- Multi-texturing via one texture blending unit per pixel pipes, allowing up to 512 texel reads per pixel in a single pass.
- 3D texture support, including projective 3D textures.
- Comprehensive support for bump mapping: emboss, dot-product, and environment bump maps.
- Improved precision in anisotropic filtering and bilinear filtering.
- Complete 3D primitive support: points, lines, triangles, lists, strips and quadrilaterals and BLTs with Z compare.
- Improved texture compositing.
- Hidden surface removal using 16, 24, or 32-bit Z-buffering (maximum Z-buffer depth is 24 bits when stencil buffer enabled) and Early Z hardware.
- 8-bit stencil buffer.
- Bilinear and trilinear texture filtering.
- Full support of Direct3D<sup>®</sup> texture lighting.
- Dithering support in 16bpp for near 24bpp quality in less memory.
- Extensive 3D mode support.
- Anti-aliasing using multi-sampling algorithm with support for 2, 4, and 6 samples.

- Optimized for full performance in true color triple buffered 32bpp acceleration modes.
- New generation rendering engine provides top 3D performance.
- Support for OpenGL format for Indirect Vertices in Vertex Walker.
- Full DirectX 9.0 support (Vertex Shader version 2.0 and Pixel Shader version 2.0):
  - Full precision floating point pixel pipeline.
  - Support for up to 4 MRTs (Multiple-Render-Targets).
  - Support for writing all texture formats from render pipe in floating points (including cube maps and 3D textures).
  - Support for up to 512bpp formats (4 color case).
  - Advanced setup engine, capable of processing 1 polygon (lit and textured) per cycle.

### 1.3.8 Motion Video Acceleration Features

- Enhanced MPEG-2 hardware decode acceleration (SD contents only), including support for:
  - Integrated general purpose iDCT engine for MPEG2 and DV decode acceleration.
  - Integrated MPEG motion compensation engine for decode acceleration.
  - Parallel operation of the iDCT and MC and high processing rates with minimal software overhead.
- Supports Microsoft DirectX Video Acceleration (DirectX VA) 2.0 (for SD contents only).
- Provides dramatically reduced CPU utilization without incurring the cost of a full MPEG-2 decoder.
- MPEG-4 simple profile support.
- Supports top quality DVD with low CPU usage.
- Hardware-based adaptive de-interlacing filter and scaler provide high quality full-screen and full-speed video playback. Minimizes the aliasing artifacts along edges usually caused by a conventional deinterlacer/scaler.

### 1.3.9 Multiple Display Features

#### General

- Dual independent displays. Possible configurations include:
    - CRT and LVDS
    - CRT and DVI/HDMI\*
    - LVDS and DVI/HDMI\*
    - LVDS and TV (component, composite, or S-Video)
    - DVI/HDMI and TV (component, composite, or S-Video)\*
- \* **Note:** The option requires implementation of the TMDS interface that is multiplexed on the PCI-E external graphics interface; see [section 1.3.11, “DVI/HDMI,” on page 1-5](#).
- Resolution, refresh rates, and display data can be completely independent for the two display paths.
  - Each display controller supports true 30bpp throughout the display pipeline.
  - Each display path supports VGA and accelerated modes, video overlay, hardware cursor, hardware icon, and palette gamma correction.
  - Supports both interlaced and non-interlaced displays.
  - Full ratiometric expansion ability is supported for source desktop modes up to 1920 pixels/line.
  - Maximum DAC frequency of 400MHz.
  - Supports 8, 16, 32 & 64-bpp depths for the main graphics layer:
    - For 32-bpp depth, supports xRGB 8:8:8:8, xRGB 2:10:10:10, sCrYCb 8:8:8:8, and xCrYCb 2:10:10:10 data formats.

- For 64-bpp depth, supports xRGB 16:16:16:16 data format.
- Independent gamma, color conversion and correction controls for main graphics layer.
- Support for DDC1 and DDC2B+ for plug and play monitors.
- 8-bit alpha blending of graphics and video overlay.
- Hardware cursor up to 64x64 pixels in 2bpp, full color AND/XOR mix, and full color 8-bit alpha blend.
- Hardware icon up to 128x128 pixels in 2bpp, with two colors, transparent, and inverse transparent. AND/XOR mixing. Supports 2x2 icon magnification.
- Virtual desktop support.
- Configurable to support flat panel displays or TVs via DVI/HDMI.
- Integrated HD Audio Controller for HDMI audio data.

### VGA Output

- Maximum resolutions supported by the VGA output for different refresh rates are:
  - 2048x1536 @85Hz (pixel clock at 388.5MHz) for 4:3 format
  - 2560x1440 @75Hz (pixel clock at 397.25MHz) for 16:9 format
  - 2456x1536 @60Hz (pixel clock at 320MHz) for 16:10 format

### TV Out

- An integrated TV encoder from AMD's Xilicon products, with an on-chip DAC (shared with the CRT analog output) (**Note:** Simultaneous output for TV and CRT is **not** supported).
- 10-bit DAC with 10-tap filter producing scaled, flicker removed, artifact suppressed display on a PAL or NTSC TV with composite, S-Video, component, and RGB output.
- With the proper BIOS implementation, supports different TV standards including NTSC, NTSC-J, PAL-M, PAL-CN, PAL-B, PAL-G, PAL-D, PAL-H, PAL-I, PAL-K, and PAL-N.
- Supports Macrovision® 7.1 copy protection standard (required by DVD players).
- Supports a maximum resolution of 1024x768 by S-video or composite video output.
- Supports 480i and 576i YUV/YCbCr component output.
- Supports the following formats of YPbPr component output: 480i, 480p, 576i, 576p, 720p, and 1080i.
- Internal adaptive flicker filtering available on both display paths for interlaced TV outputs.
- Supports fully-programmable 2D, adaptive comb filter for composite output.
- TV-out power management support.
- Line 21 Closed Caption and Extended Data Service support for encoding in Vertical Blanking Interval (VBI) of TV signal.
- CGMS copy management support in VBI through Line-20 and/or Extended Data Service (Line-21 Field 2) for NTSC, and through Wide Screen Signaling data (WSS) for PAL.

## 1.3.10 Integrated LVDS

- Integrated dual-link 24-bit LVDS interface.
- 805 Mbps/channel with 115MHz pixel clock rate per link (230MHz maximum pixel clock).
- FPDI-2 compliant; compatible with receivers from National Semiconductor, Texas Instruments, and THine.
- OpenLDI compliant excluding DC balancing.
- Programmable internal spread spectrum controller for the signals.

## 1.3.11 DVI/HDMI

- Supports a TMDS interface, enabling DVI or HDMI\*, which is multiplexed on the PCI-E external graphics interface (only available if no external graphics card is attached to the PCI-E external graphics interface).

- Supports industry standard EIA-861B video modes including 480p, 720p, and 1080i. For a full list of currently supported modes, contact your AMD CSS representative. Maximum resolutions supported by various modes are:
  - Single-link DVI: 1600x1200 @60Hz with pixel clock at 162 MHz and standard timings; 1920x1200 @60Hz with pixel clock at 154MHz and reduced blanking timings.
  - Dual-link DVI: 2560x1600 @60Hz, with pixel clock at 268 MHz (DVI clock at 134 MHz).
  - HDMI: 1080i, with pixel clock at 74MHz.
- HDMI basic audio support at 32, 44.1, and 48 kHz. Supports two-channel uncompressed audio and multi-channel audio compressed to two channels like 5.1 DTS, AC3, etc, for audio bit rates up to 1.5 Mbits/s. HD Audio device compatible with Microsoft's HD audio drivers.
- HD Audio device compatible with Microsoft's HD audio drivers.
- HDCP support on data stream for single-link transmission, with on-chip key storage.\*\*

**Notes:** \* CEC is not supported.

\*\* HDCP content protection is only available to licensed buyers of the technology and can only be enabled when connected to an HDCP-capable receiver.

### 1.3.12 Power Management Features

- Fully supports ACPI states S1, S3, S4, and S5.
- The chip power management support logic supports four device power states defined for the OnNow Architecture—On, Standby, Suspend, and Off. Each power state can be achieved by software control bits.
- Hardware controlled intelligent clock gating enables clocks only to active functional blocks, and is completely transparent to software.
- Dynamic self-refresh for the side-port memory.
- Support for AMD Cool'n'Quiet™ technology via FID/VID change.
- Support for AMD PowerNow!™ technology.
- Clocks to every major functional block are controlled by a unique dynamic clock switching technique that is completely transparent to the software. By turning off the clock to the block that is idle or not used at that point, the power consumption is significantly reduced during normal operation.
- Supports ATI PowerExpress™, and ATI PowerPlay™ (enhanced with the new ATI PowerShift™ feature).
- Support dynamic lane reduction for the PCI-E interfaces, adjusting lane width according to required bandwidth (not available on the PCI-E graphics link when lane reversal is in effect).

### 1.3.13 PC Design Guide Compliance

The M690T complies with all relevant Windows Logo Program (WLP) requirements from Microsoft for WHQL certification.

### 1.3.14 Test Capability Features

The M690T has a variety of test modes and capabilities that provide a very high fault coverage and low DPM (Defect Per Million) ratio:

- Full scan implementation on the digital core logic through ATPG (Automatic Test Pattern Generation) vectors.
- Dedicated test logic for the on-chip custom memory macros to provide complete coverage on these modules.
- A JTAG test mode to allow board level testing of neighboring devices.
- An EXOR tree test mode on all the digital I/O's to allow for proper soldering verification at the board level.
- A VOH/VOL test mode on all digital I/O's to allow for proper verification of output high and output low values at the board level.
- Improved access to the analog modules to allow full evaluation and characterization.
- Improved IDDQ mode support to allow chip evaluation through current leakage measurements.



These test modes can be accessed through the settings on the instruction register of the JTAG circuitry.

### 1.3.15 Additional Features

- Integrated spread spectrum PLLs on the memory and LVDS interface.

### 1.3.16 Packaging

- Single chip solution in 80nm, 1.0-1.2V low power CMOS technology.
- 465-FCBGA package, 21mmx21mm.

## 1.4 Software Features

- Supports Microsoft Windows XP and Windows Vista operating systems.
- BIOS ability to read EDID 1.1, 1.2, and 1.3.
- Ability to selectively enable and disable several devices including CRT, LCD, TV, and DFP.
- Register-compatible with VGA standards, BIOS-compatible with VESA VBE2.0.
- Supports corporate manageability requirements such as DMI.
- ACPI support.
- Full Write Combining support for maximum performance of the CPU.
- Full-featured, yet simple Windows utilities:
  - Calibration utility for WYSIWYG color
  - Independent brightness control of desktop and overlay
  - End user diagnostics
- Drivers meet Microsoft's rigorous WHQL criteria and are suitable for systems with the "Designed for Windows" logos.
- Comprehensive OS and API support.
- Hot-key support (Windows ACPI 1.0b or AMD Event Handler Utility where appropriate).
- Extensive power management support.
- Rotation mode support in software.
- Dual CRTC, simultaneous view, extended desktop support (Windows XP and Windows Vista)
- DirectX 9.0 support.
- Switchable overlay support.
- H.264 playback support.

## 1.5 Branding Diagrams

### 1.5.1 Branding Diagram for ASIC Revision A11

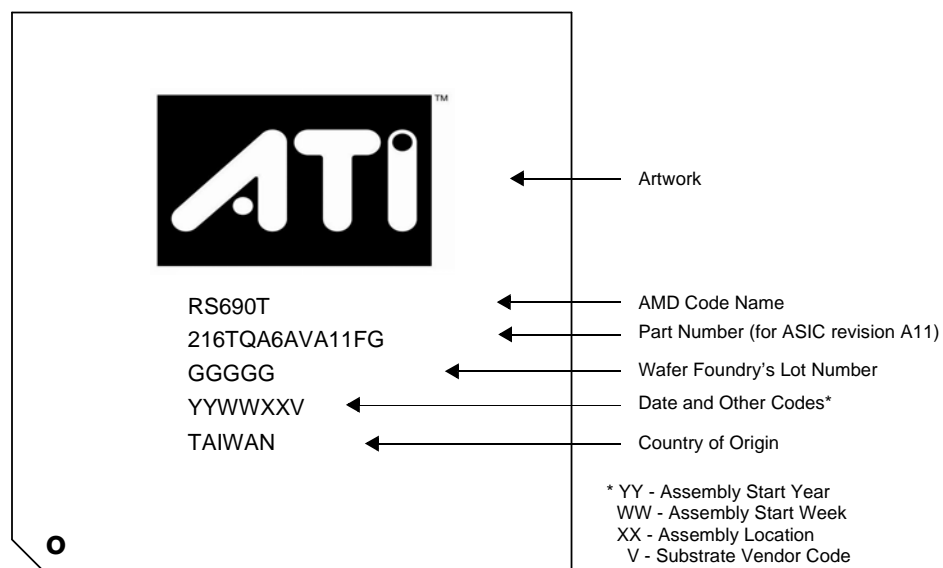


Figure 1-1 M690T Branding Diagram for ASIC Revision A11

### 1.5.2 Branding Diagram for ASIC Revision A12 and After

**Note:** The branding diagram below does not necessarily contain the latest ASCII revision number for the M690T. Unless specified otherwise, no information in this databook is specific to the ASIC revision number given in the diagram.

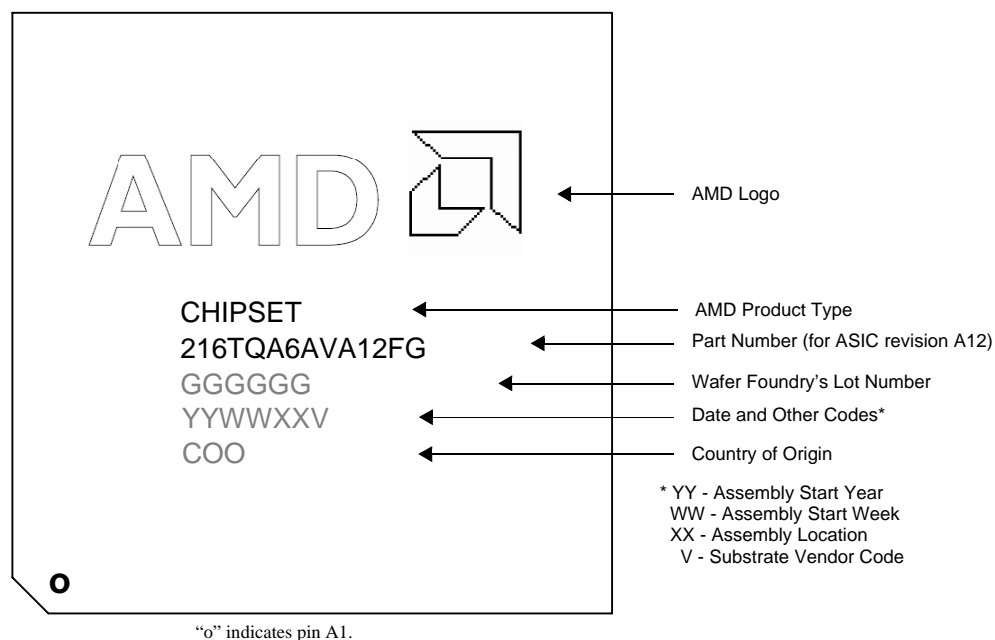


Figure 1-2 M690T Branding Diagram for ASIC Revision A12

1.6 Part Number Legend

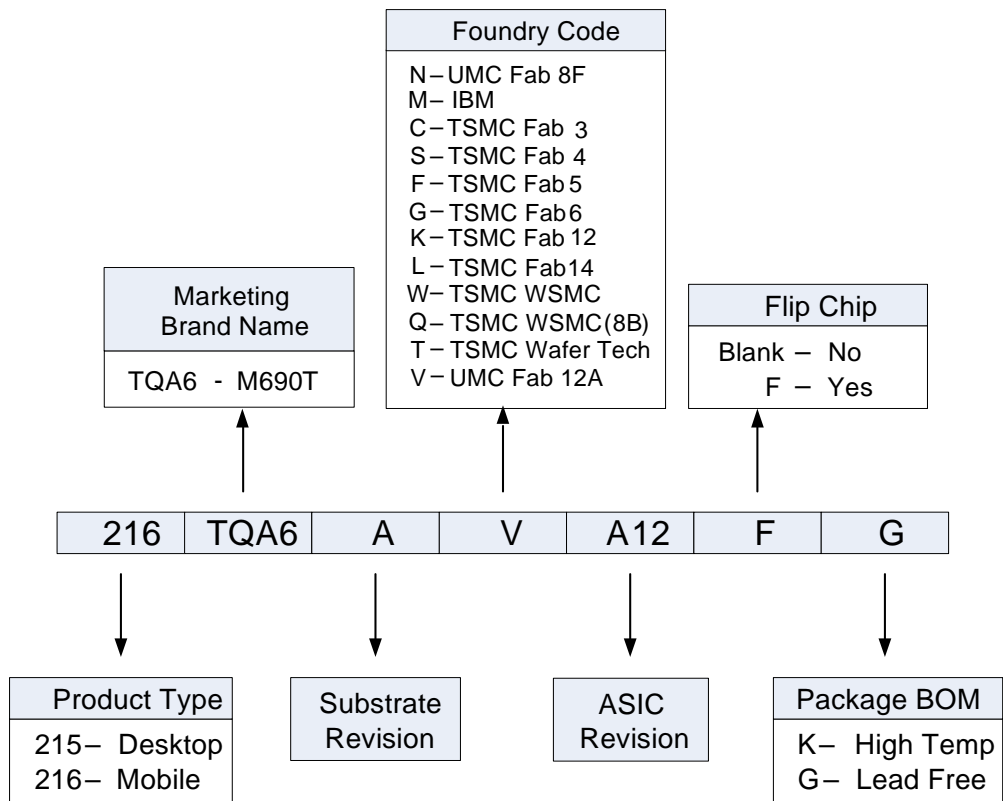


Figure 1-3 M690T ASIC Part Number Legend

1.7 Production Schedule, OPN, and Part Marking

The part marking, planned production schedule, and AMD OPN (ordering numbering) for the M690T are shown in [Table 1-1](#).

Table 1-1 M690T Planned production Schedule, OPN, and Part Marking

Component	Production Availability Date	OPN	Part Marking
M690T	In production now	100-CG1292	216TQA6AVA12FG

1.8 Conventions and Notations

The following conventions are used throughout this manual.

1.8.1 Pin Names

Pins are identified by their pin names or ball references. Multiplexed pins assume alternate “functional names” when they perform their alternate functions, and these “functional names” are given in [Chapter 3, “Pin Descriptions and Strap Options.”](#)

All active-low signals are identified by the suffix ‘#’ in their names (e.g., LDTSTOP#).

1.8.2 Pin Types

The pins are assigned different codes according to their operational characteristics. These codes are listed in [Table 1-2](#).

Table 1-2 Pin Type Codes

Code	Pin Type
I	Digital Input
O	Digital Output
OD	Open Drain
I/O	Bi-Directional Digital Input or Output
M	Multifunctional
Pwr	Power
Gnd	Ground
A-O	Analog Output
A-I	Analog Input
A-I/O	Analog Bi-Directional Input/Output
A-Pwr	Analog Power
A-Gnd	Analog Ground
Other	Pin types not included in any of the categories above

### 1.8.3 Numeric Representation

Hexadecimal numbers are appended with “h” (Intel assembly-style notation) whenever there is a risk of ambiguity. Other numbers are in decimal.

Pins of identical functions but different trailing integers (e.g., “CPU\_D0, CPU\_D1,... CPU\_D7”) are referred to collectively by specifying their integers in square brackets and with colons (i.e., “CPU\_D[7:0]”). A similar short-hand notation is used to indicate bit occupation in a register. For example, NB\_COMMAND[15:10] refers to the bit positions 10 through 15 of the NB\_COMMAND register.

### 1.8.4 Register Field

A field of a register is referred to by the format of [Register Name].[Register.Field]. For example, “NB\_MC\_CNTL.DISABLE\_BYPASS” is the “DISABLE\_BYPASS” field of the register “NB\_MC\_CNTL.”

### 1.8.5 Hyperlinks

Phrases or sentences in *blue italic font* are hyperlinks to other parts of the manual. Users of the PDF version of this manual can click on the links to go directly to the referenced sections, tables, or figures.

### 1.8.6 Acronyms and Abbreviations

The following is a list of the acronyms and abbreviations used in this manual.

Table 1-3 Acronyms and Abbreviations

Acronym	Full Expression
ACPI	Advanced Configuration and Power Interface
A-Link-E II	A-Link Express II interface between the IGP and the Southbridge.
BGA	Ball Grid Array
BIOS	Basic Input Output System. Initialization code stored in a ROM or Flash RAM used to start up a system or expansion card.
BIST	Built In Self Test.
BLT	Blit
bpp	bits per pixel
CEC	Consumer Electronic Control
CPIS	Common Panel Interface Specification
CRT	Cathode Ray Tube
CSP	Chip Scale Package

**Table 1-3 Acronyms and Abbreviations (Continued)**

Acronym	Full Expression
DAC	Digital to Analog Converter
DBI	Dynamic Bus Inversion
DDC	Display Data Channel. A VESA standard for communicating between a computer system and attached display devices.
DDR	Double Data Rate
DFP	Digital Flat Panel. Monitor connection standard from VESA.
DPM	Defects per Million
DTV	Digital TV
DVD	Digital Video Disc
DVI	Digital Video Interface. Monitor connection standard from the DDWG (Digital Display Work Group).
DVS	Digital Video Stream
EPROM	Erasable Programmable Read Only Memory
FIFO	First In, First Out
FPDI	Flat Panel Display Interface
GDI	Graphics Device Interface
GND	Ground
GPIO	General Purpose Input/Output
GTL+	Gunning Transceiver Logic
HDCP	High-Bandwidth Digital Content Protection
HDMI	High Definition Multimedia Interface
HDTV	High Definition TV. The 1920x1080 and the 1280x720 modes defined by ATSC.
HPD	Hot Plug Detect
iDCT	inverse Discrete Cosine Transform
IDDQ	Direct Drain Quiescent Current
IGP	Integrated Graphics Processor. A single device that integrates a graphics processor and a system controller.
JTAG	Joint Test Access Group. An IEEE standard.
LVDS	Low Voltage Differential Signaling
MB	Mega Byte
MPEG	Motion Pictures Experts Group. Refers to compressed video image streams in either MPEG-1 or MPEG-2 formats.
NTSC	National Television Standards Committee. The standard definition TV system used in North America and other areas.
PAL	Phase Alternate Line. The standard definition TV system used in Europe and other areas.
PCI	Peripheral Component Interface
PCI-E	PCI Express
PCMCIA	Personal Computer Memory Card International Association. It is also the name of a standard for PC peripherals promoted by the Association.
PLL	Phase Locked Loop
POST	Power On Self Test
PD	Pull-down Resistor
PU	Pull-up Resistor
ROP	Raster Operation
SDRAM	Synchronous Dynamic RAM
TMDS	Transition Minimized Differential Signaling
UMA	Unified Memory Architecture
UV	Chrominance (also CrCb). Corresponds to the color of a pixel.
UXGA	Ultra Extended Graphics Array
VBI	Vertical Blank Interval
VESA	Video Electronics Standards Association

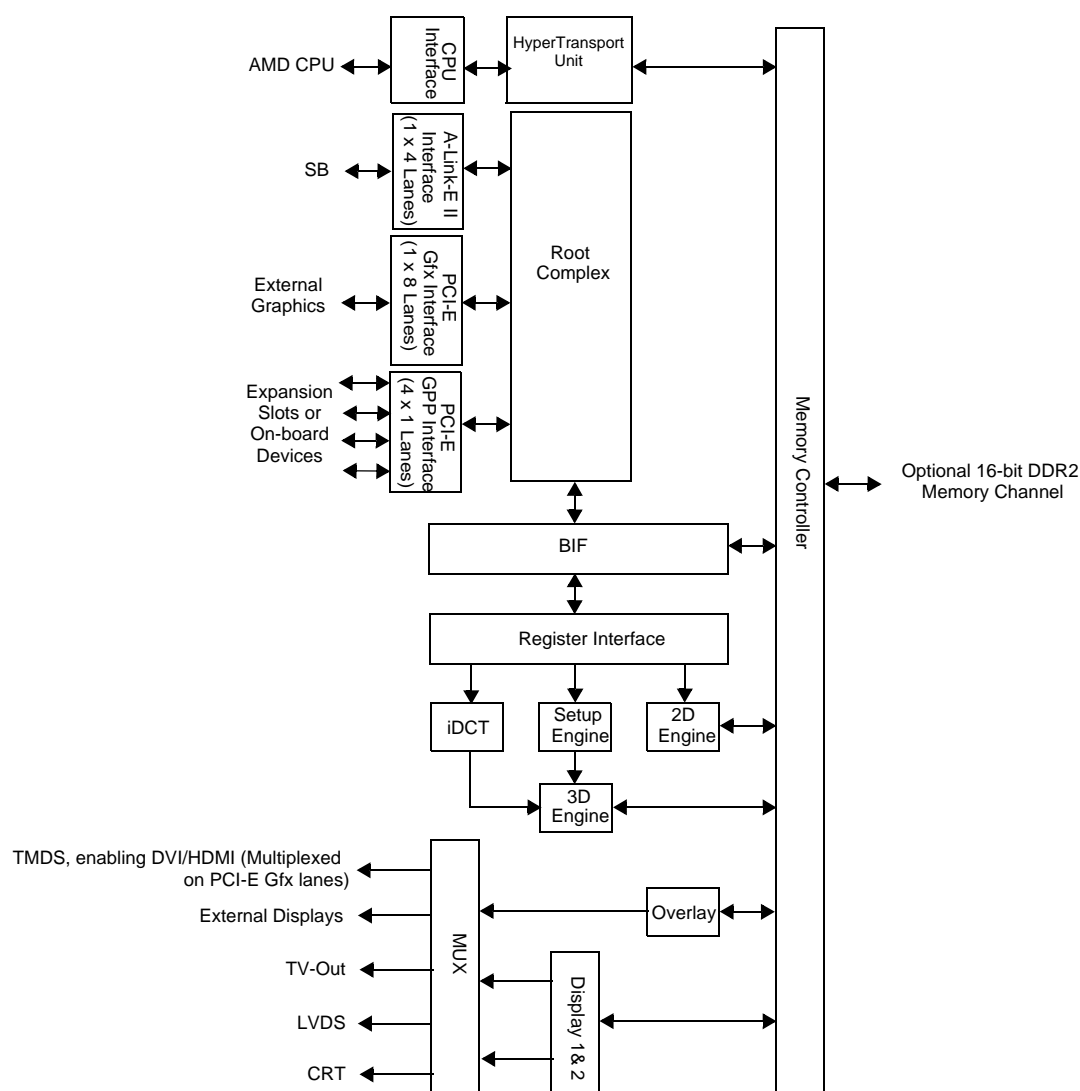
Table 1-3 Acronyms and Abbreviations (Continued)

Acronym	Full Expression
VGA	Video Graphics Adapter
VRM	Voltage Regulation Module

# Chapter 2

## Functional Descriptions

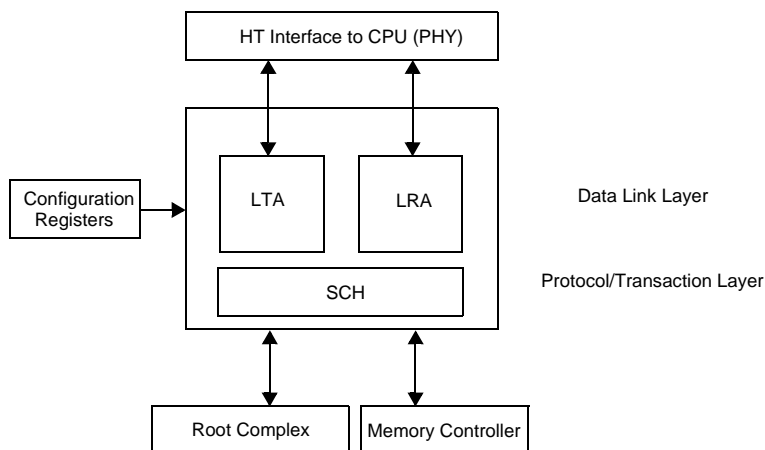
This chapter describes the functional operation of the major interfaces of the M690T system logic chip. *Figure 2-1, “M690T Internal Block Diagram,”* illustrates the M690T internal blocks and interfaces.



**Figure 2-1 M690T Internal Block Diagram**

## 2.1 Host Interface

The M690T is optimized to interface with the Athlon 64/Athlon 64 FX/Athlon X2/AMD Sempron/AMD Turion 64 processors, including both AM2 and S1 socket CPUs. This section presents an overview of the HyperTransport™ interface. For a detailed description of the interface, please refer to the HyperTransport I/O Link Specification from the HyperTransport Consortium. [Figure 2-2, “Host Interface Block Diagram,”](#) illustrates the basic blocks of the host bus interface of the M690T.

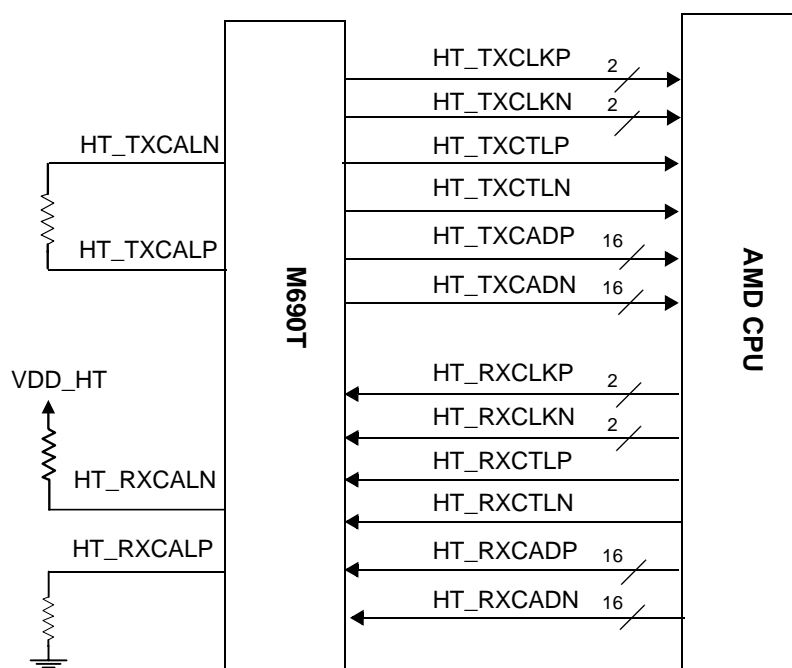


**Figure 2-2 Host Interface Block Diagram**

The HyperTransport (HT) Interface, formerly known as the LDT (Lightning Data Transport) interface, is a high speed, packet-based link implemented on two unidirectional buses. It is a point-to-point interface where data can flow both upstream and downstream at the same time. The commands, addresses, and data travel in packets on the HyperTransport link. Lengths of packets are in multiples of four bytes. The HT link consists of three parts: the physical layer (PHY), the data link layer, and the protocol/transaction layer. The PHY is the physical interface between the M690T and the CPU. The data link layer includes the initialization and configuration sequences, periodic redundancy checks, connect/disconnect sequences, and information packet flow controls. The protocol layer is responsible for maintaining strict ordering rules defined by the HT protocol.

The M690T HyperTransport bus interface consists of 17 unidirectional differential data/control pairs and two differential clock pairs in each of the upstream and downstream direction. On power up, the HT link is 8 bits wide and runs at a default speed of 200MT/s. After negotiation, carried out by the HW and SW together, the link width can be brought up to 16 bits and the interface can run up to 2GT/s. The interface is illustrated in [Figure 2-3, “M690T Host Bus Interface Signals,”](#) on page 2-3. The signal name and direction for each signal is shown with respect to the processor. Please note that the signal names may be different from those used in the pin listing of the M690T. Detailed descriptions of the signals are given in [section 3.3, “CPU HyperTransport™ Interface,”](#) on page 3-5.





**Figure 2-3 M690T Host Bus Interface Signals**

## 2.2 Side-port Memory Interface

In order to significantly decrease system power and increase graphics performance, the M690T provides an optional side-port memory interface for dedicated frame buffer memory, to be used exclusively for the integrated graphics core. The side-port memory interface can significantly reduce system power by allowing the CPU to stay in its lowest power state during periods of inactivity. Screen refreshes are fetched from the side-port memory, and there is no need to "wake up" the CPU to fetch screen refresh data.

The M690T memory controller is unique and highly optimized. It operates in 16-bit mode at very high speed (up to DDR2-800), and has a new programmable interleaved mode that significantly increases the memory bandwidth and reduces data latency to the integrated graphics core. The additional bandwidth provided to the internal graphics core will also aid the M690T in reaching and exceeding Microsoft's Windows Vista™ Premium logo requirements.

### 2.2.1 DDR2 Memory Interface

*Figure 2-4, "M690T Side-port Memory Interface," on page 2-4, illustrates the side-port memory interface of the M690T.*

The M690T memory controller supports up to 128MB of dedicated side-port frame buffer memory. It controls a single rank of DDR2 devices in 16-bit memory configuration. It supports device sizes of 256, 512, and 1024 Mbit, and device widths of x8 and x16. Because the memory controller supplies only one chip select signal, only DDR2 devices with one chip select are supported. A wide range of DDR2 timing parameters, configurations, and loadings are programmable via the M690T memory controller configuration registers.

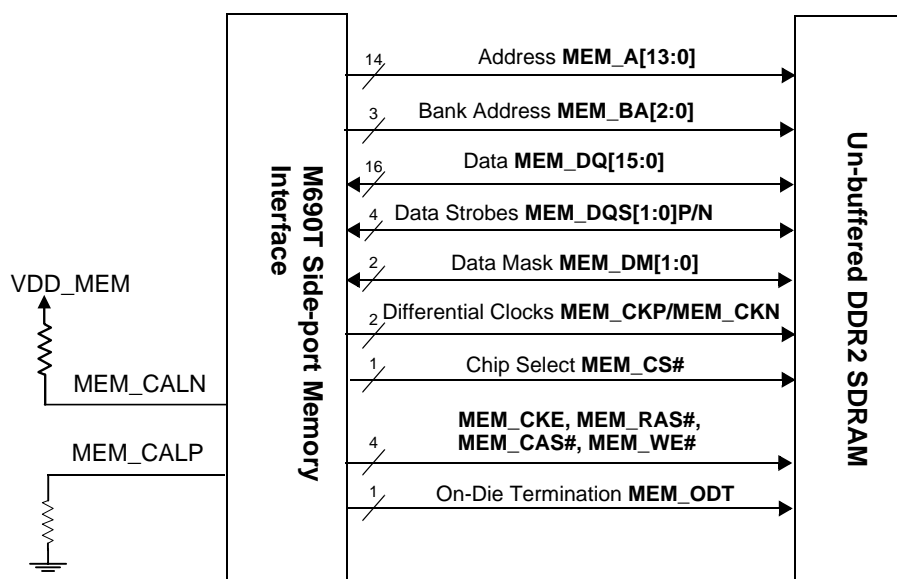


Figure 2-4 M690T Side-port Memory Interface

### 2.2.1.1 Supported DDR2 Components

The memory controller supports DDR2 SDRAM chips in several configurations. These chips are organized in banks, rows (or pages), and columns. The supported DDR2 components have four or eight banks. [Table 2-1](#) lists the supported memory components.

Table 2-1 Supported DDR2 Components

DDR2 SDRAM						Mbytes
Config	Mbits	CS Mode	Bank Bits	Row Bits	Col Bits	
16Mbits x 16	256	4	2	13	9	32
32Mbits x 8	256	5	2	13	10	64
32Mbits x 16	512	10	2	13	10	64
64Mbits x 8	512	6	2	14	10	128
64Mbits x 16	1024	11	3	13	10	128

### 2.2.1.2 Row and Column Addressing

[Table 2-2](#) shows how the physical address P (after taking out the bank bit) is used to provide the row and column addressing for each size of DDR2 memories.

Table 2-2 DDR2 Memory Row and Column Addressing

Address														
	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
16Mbits x16 devices														
Row		P10	P14	P13	P12	P11	P22	P21	P20	P19	P18	P17	P16	P15
Column		-	-	PC	-	P9	P8	P7	P6	P5	P4	P3	P2	P1
32Mbits x8 devices														
Row		P23	P14	P13	P12	P11	P22	P21	P20	P19	P18	P17	P16	P15
Column		-	-	PC	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1

Address														
	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
32Mbits x16 devices														
Row		P23	P14	P13	P12	P11	P22	P21	P20	P19	P18	P17	P16	P15
Column		-	-	PC	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1
64Mbits x8 devices														
Row	P24	P23	P14	P13	P12	P11	P22	P21	P20	P19	P18	P17	P16	P15
Column		-	-	PC	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1
64Mbits x16 devices														
Row		P23	P14	P13	P12	P11	P22	P21	P20	P19	P18	P17	P16	P15
Column		-	-	PC	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1

**Note:** PC = precharge flag

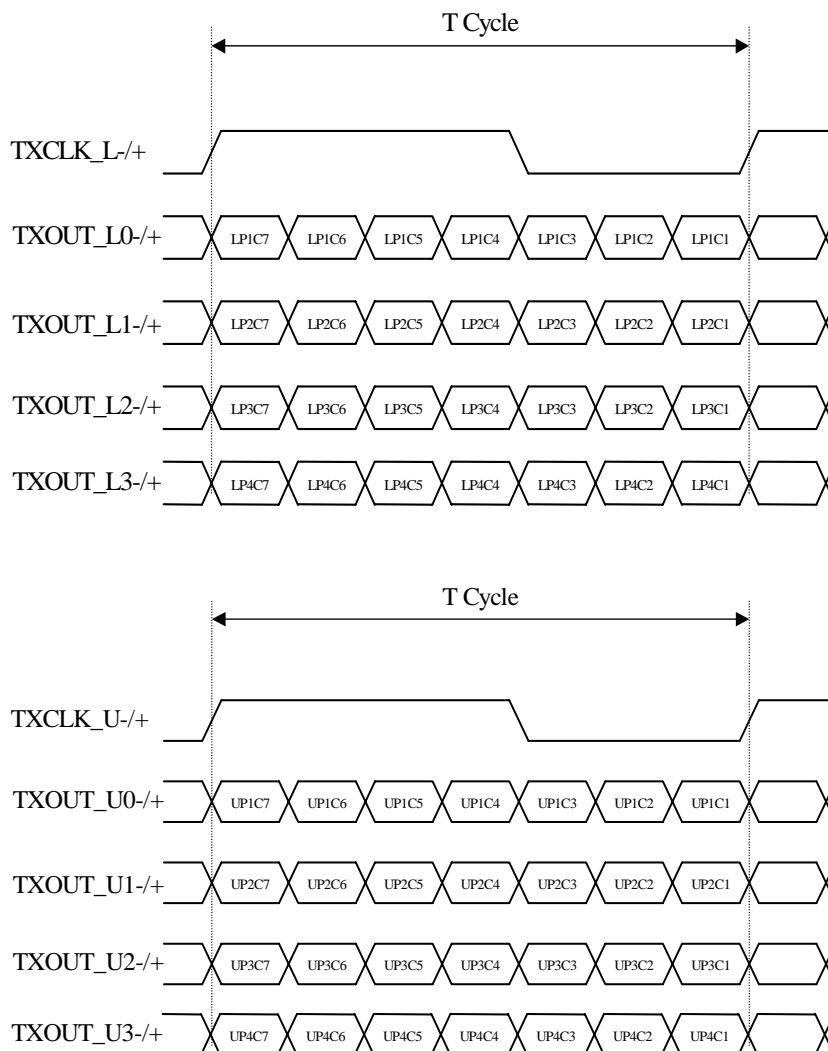
## 2.3 LVDS Interface

The M690T contains a dual-channel 24-bit LVDS interface. Notice that for designs implementing only a single LVDS channel, the LOWER channel of the interface should be used.

### 2.3.1 LVDS Data Mapping

*Figure 2-5* below shows the transmission ordering of the LVDS signals on the lower and the upper data channels.

The signal mappings for single and dual channel transmission are shown in *Table 2-3* and *Table 2-4* respectively.



**Figure 2-5 Single/Dual Channel 24-bit LVDS Data Transmission Ordering**

**Table 2-3 LVDS 24-bit TFT Single Pixel per Clock (Single Channel) Signal Mapping**

<b>TX Signal</b>	<b>24-bit</b>
LP1C1	R0
LP1C2	R1
LP1C3	R2
LP1C4	R3
LP1C5	R4
LP1C6	R5
LP1C7	G0
LP2C1	G1
LP2C2	G2
LP2C3	G3
LP2C4	G4
LP2C5	G5
LP2C6	B0
LP2C7	B1
LP3C1	B2
LP3C2	B3
LP3C3	B4
LP3C4	B5
LP3C5	HSYNC
LP3C6	VSYNC
LP3C7	ENABLE
LP4C1	R6
LP4C2	R7
LP4C3	G6
LP4C4	G7
LP4C5	B6
LP4C6	B7
LP4C7	Reserved

Table 2-4 LVDS 24-bit TFT Dual Pixel per Clock (Dual Channel) Signal Mapping

TX Signal	24-bit	TX Signal	24-bit
LP1C1	Ro0	UP1C1	Re0
LP1C2	Ro1	UP1C2	Re1
LP1C3	Ro2	UP1C3	Re2
LP1C4	Ro3	UP1C4	Re3
LP1C5	Ro4	UP1C5	Re4
LP1C6	Ro5	UP1C6	Re5
LP1C7	Go0	UP1C7	Ge0
LP2C1	Go1	UP2C1	Ge1
LP2C2	Go2	UP2C2	Ge2
LP2C3	Go3	UP2C3	Ge3
LP2C4	Go4	UP2C4	Ge4
LP2C5	Go5	UP2C5	Ge5
LP2C6	Bo0	UP2C6	Be0
LP2C7	Bo1	UP2C7	Be1
LP3C1	Bo2	UP3C1	Be2
LP3C2	Bo3	UP3C2	Be3
LP3C3	Bo4	UP3C3	Be4
LP3C4	Bo5	UP3C4	Be5
LP3C5	HSYNC	UP3C5	(from the register)
LP3C6	VSYNC	UP3C6	(from the register)
LP3C7	ENABLE	UP3C7	(from the register)
LP4C1	Ro6	UP4C1	Re6
LP4C2	Ro7	UP4C2	Re7
LP4C3	Go6	UP4C3	Ge6
LP4C4	Go7	UP4C4	Ge7
LP4C5	Bo6	UP4C5	Be6
LP4C6	Bo7	UP4C6	Be7
LP4C7	Reserved	UP4C7	Reserved

**Note:** Signal names with letter 'o' mean 'odd' pixel or the first pixel on the panel, and signal names with letter 'e' mean 'even' pixel or the second pixel on the panel.

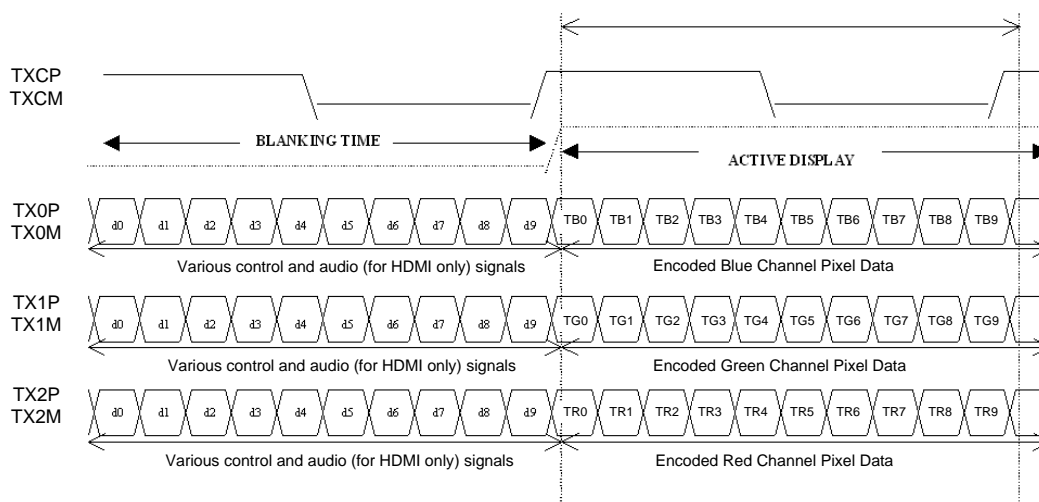
### 2.3.2 LVDS Spread Spectrum

The M690T has an internal LVDS spread spectrum controller capable of generating a frequency modulated profile for the LVDS signals. The amount of spread (center spread of up to +/-2.5% and down spread of up to 5%) and the modulation frequency (in the range of 20-50kHz) are programmable through the LVDS registers.

## 2.4 DVI/HDMI

### 2.4.1 DVI/HDMI Data Transmission Order and Signal Mapping

The M690T also contains a dual-link TMDS interface, multiplexed on the PCI Express<sup>®</sup> (PCI-E) graphics lanes. [Figure 2-6](#) below shows the transmission ordering of the signals on the interface. The multiplexing relationships between the PCI-E external graphics signals and the TMDS signals are given in [section 3.9, “TMDS Interface Multiplexed on the PCI Express<sup>®</sup> Graphics Lanes,”](#) on page 3-9.



**Figure 2-6 Data Transmission Ordering for the TMDS Interface**

For dual-link mode, which is for DVI only, the same transmission order applies to data channels on the second link, with the first link transmitting data for even pixels and the second link for odd pixels. See [Table 2-6, “Dual-Link Signal Mapping for DVI,”](#) on page 2-11 for details.

The signal mapping for the transmission is shown in [Table 2-5, “Single-Link Signal Mapping for DVI/HDMI,”](#) on page 2-10, and [Table 2-6, “Dual-Link Signal Mapping for DVI,”](#) on page 2-11.

Table 2-5 Single-Link Signal Mapping for DVI/HDMI

DVI/HDMI Functional Name	Data Phase	Signal
TX0M/P	Phase 1	B0
	Phase 2	B1
	Phase 3	B2
	Phase 4	B3
	Phase 5	B4
	Phase 6	B5
	Phase 7	B6
	Phase 8	B7
	Phase 9	B8
	Phase 10	B9
TX1M/P	Phase 1	G0
	Phase 2	G1
	Phase 3	G2
	Phase 4	G3
	Phase 5	G4
	Phase 6	G5
	Phase 7	G6
	Phase 8	G7
	Phase 9	G8
	Phase 10	G9
TX2M/P	Phase 1	R0
	Phase 2	R1
	Phase 3	R2
	Phase 4	R3
	Phase 5	R4
	Phase 6	R5
	Phase 7	R6
	Phase 8	R7
	Phase 9	R8
	Phase 10	R9

**Note:** H/VSNC are transmitted on TX0M/P(Blue) channel during blank.



Table 2-6 Dual-Link Signal Mapping for DVI

Link 1			Link 2		
DVI Functional Name	Data Phase	Signal	DVI Functional Name	Data Phase	Signal
TX0M/P	Phase 1	EVEN_B0	TX3M/P	Phase 1	ODD_B0
	Phase 2	EVEN_B1		Phase 2	ODD_B1
	Phase 3	EVEN_B2		Phase 3	ODD_B2
	Phase 4	EVEN_B3		Phase 4	ODD_B3
	Phase 5	EVEN_B4		Phase 5	ODD_B4
	Phase 6	EVEN_B5		Phase 6	ODD_B5
	Phase 7	EVEN_B6		Phase 7	ODD_B6
	Phase 8	EVEN_B7		Phase 8	ODD_B7
	Phase 9	EVEN_B8		Phase 9	ODD_B8
	Phase 10	EVEN_B9		Phase 10	ODD_B9
TX1M/P	Phase 1	EVEN_G0	TX4M/P	Phase 1	ODD_G0
	Phase 2	EVEN_G1		Phase 2	ODD_G1
	Phase 3	EVEN_G2		Phase 3	ODD_G2
	Phase 4	EVEN_G3		Phase 4	ODD_G3
	Phase 5	EVEN_G4		Phase 5	ODD_G4
	Phase 6	EVEN_G5		Phase 6	ODD_G5
	Phase 7	EVEN_G6		Phase 7	ODD_G6
	Phase 8	EVEN_G7		Phase 8	ODD_G7
	Phase 9	EVEN_G8		Phase 9	ODD_G8
	Phase 10	EVEN_G9		Phase 10	ODD_G9
TX2M/P	Phase 1	EVEN_R0	TX5M/P	Phase 1	ODD_R0
	Phase 2	EVEN_R1		Phase 2	ODD_R1
	Phase 3	EVEN_R2		Phase 3	ODD_R2
	Phase 4	EVEN_R3		Phase 4	ODD_R3
	Phase 5	EVEN_R4		Phase 5	ODD_R4
	Phase 6	EVEN_R5		Phase 6	ODD_R5
	Phase 7	EVEN_R6		Phase 7	ODD_R6
	Phase 8	EVEN_R7		Phase 8	ODD_R7
	Phase 9	EVEN_R8		Phase 9	ODD_R8
	Phase 10	EVEN_R9		Phase 10	ODD_R9

**Notes:**

- H/VSYNCR are transmitted on TX0M/P(Blue) channel during blank.
- For DVI dual-link mode, the first active data pixel is defined as pixel#0 (an even pixel), as opposed to the DVI specifications.

## 2.4.2 Support for HDMI Packet Types

Table 2-7 Support for HDMI Packet Type

Packet Value	Packet Type	Supported or Not	Source	Comment
0x00	Null	Yes	Inserted by hardware if no packets in horizontal active on line 2 (can be disabled by software).	Sent when required to meet maximum time between data island specification.
0x01	Audio Clock Regeneration	Yes	Inserted by hardware or video driver. Contents from register bits or combination of register bits and hardware control. Inserted in horizontal blank.	—
0x02	Audio Sample	Yes	Audio samples come from HD audio DMA. Channel status from HD audio and video registers. Inserted in horizontal blank whenever audio FIFO contains data.	—
0x03	General Control	No	Sending and contents controlled by video driver. Inserted (on even frames only in interlaced mode) when requested by software or whenever AVMUTE status changes. Inserted in horizontal active on line selected by software.	—
0x04	ACP Packet	Yes*	—	Audio content protection information.
0x05	ISRC1 Packet	Yes	Controlled by video driver. Inserted in horizontal active on line selected by software.	For transmitting UPC or ISRC codes.
0x06	ISRC2 Packet	Yes	Software controlled. Inserted in horizontal active on line selected by software.	Implement if ISRC1 is used.
0x07	Reserved	N/A	N/A	N/A
<b>InfoFrame Packet Type</b>				
HDMI ID	EIA-861B ID			
0x80	0x00	Vendor-Specific	Yes*	—
0x81	0x01	AVI	Yes	Controlled by video driver. Inserted in horizontal active on line selected by software. For colorimetry, repetition count, video format, picture formatting.
0x82	0x02	Source Product Descriptor	Yes*	—
0x83	0x03	Audio	Yes	Inserted in horizontal active on line selected by software. Contents from registers written by video and HD audio drivers. Sent only when HD audio enables audio (video driver can also disable). For channel counts, sampling frequency, etc.
0x84	0x04	MPEG Source	Yes	Software controlled. Inserted in horizontal active on line selected by software. For bit rate, field repeat, frame type

\* **Note:** These packet types are supported using generic packet types. A maximum of two of them can be supported simultaneously.

## 2.5 VGA DAC Characteristics

**Table 2-8 VGA DAC Characteristics**

Parameter	Min	Typ	Max	Notes
Resolution	10 bits	-	-	1
Maximum PS/2 setting Output Voltage	-	0.7V	-	1, 10
Maximum PS/2 setting Output Current	-	18.7mA	-	1, 10
Full Scale Error	+8% / -3%	-	+10%	2, 3
DAC to DAC Correlation	-2%	-	+2%	1, 4
Differential Linearity	-2 LSB	-	+2 LSB	1, 5
Integral Linearity	-2 LSB	-	+2 LSB	1, 5
Rise Time (10% to 90%)	0.58ns	-	1.7ns	1, 6
Full Scale Settling Time	-	TBA	-	1, 7, 8
Glitch Energy	-	TBA	-	1, 8
Monotonicity	-	-	-	9

**Notes:**

- 1 Tested over the operating temperature range at nominal supply voltage, with an Iref of -1.50mA (Iref is the level of the current flowing out of the RSET resistor).
- 2 Tested over the operating temperature range at reduced supply voltage, with an Iref of -1.50mA (Iref is the level of the current flowing out of the RSET resistor).
- 3 Full scale error from the value predicted by the design equations.
- 4 About the mid-point of the distribution of the three DACs measured at full scale deflection.
- 5 Linearity measured from the best fit line through the DAC characteristics. Monotonicity guaranteed.
- 6 Load = 37.5Ω + 20pF with Iref = -1.50 mA (Iref is the current flowing out of the RSET resistor).
- 7 Measured from the end of the overshoot to the point where the amplitude of the video ringing is down to +/-5% of the final steady state value.
- 8 This parameter is sampled, not 100% tested.
- 9 Monotonicity is guaranteed.
- 10 Levels are 7.8% higher with setup pedestal enabled.

## 2.6 External Clock Chip

On the M690T platform, an external clock chip provides the reference clock to the CPU (for generating the CPU internal clocks) and a reference clock to the M690T (for generating the HyperTransport, PCI Express, and A-Link Express II clocks). For more information about supported clock chips, please consult your AMD CSS representative.

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# Chapter 3

## Pin Descriptions and Strap Options

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This chapter gives the pin descriptions and the strap options for the M690T. To jump to a topic of interest, use the following list of hyperlinked cross references:

[“Pin Assignment” on page 3-2](#)

[“Interface Block Diagram” on page 3-4](#)

[“CPU HyperTransport™ Interface” on page 3-5](#)

[“DDR2 Side-port Memory Interface” on page 3-5](#)

[“PCI Express® Interfaces” on page 3-6:](#)

[“1 x 8 Lane Interface for External Graphics” on page 3-6](#)

[“A-Link Express II to Southbridge” on page 3-6](#)

[“4 x 1 Lane Interface for General Purpose External Devices” on page 3-6](#)

[“Miscellaneous PCI Express® Signals” on page 3-6](#)

[“Clock Interface” on page 3-7](#)

[“CRT and TV Interface” on page 3-7](#)

[“LVDS Interface \(24 Bits\)” on page 3-8](#)

[“TMDS Interface Multiplexed on the PCI Express® Graphics Lanes” on page 3-9](#)

[“Power Management Pins” on page 3-10](#)

[“Miscellaneous Pins” on page 3-10](#)

[“Power Pins” on page 3-11](#)

[“Ground Pins” on page 3-12](#)

[“Debug Port Signals” on page 3-12](#)

[“Strapping Options” on page 3-13](#)

## 3.1 Pin Assignment

### 3.1.1 M690T Pin Assignment

Figure 3-1 and Figure 3-2 below show the pin assignment for the M690T.

The figures below only represent the relative ball positions. For the actual physical layout of the balls, please refer to Figure 5-4, “M690T Ball Arrangement,” on page 5- 8.

	1	2	3	4	5	6	7	8	9	10	11	12	13
A	VSSA	I2C_CLK	STRP_DATA	VDD_CORE	DACHSYNC	DACSDA	VDD_CORE	DFT_GPIO5	VDD_CORE	PLLVD18	PLLVD12	LVDDR18D	TXOUT_L1N
B	VDDA_12	BMREQ#	DDC_DATA	I2C_DATA	ALLOW_LDTSTOP	DACSCL	VSS	DFT_GPIO4	VDD_CORE	PLLVS	OSCIN	LVDDR18D	TXOUT_L1P
C	VDDA_12	TVCLKIN	TESTMODE	VSS	LDSTOP#	DACVSYNC	DFT_GPIO3	DFT_GPIO2	VDD_CORE	SYSRESET#	POWERGOOD	LVDDR33	LVDDR33
D	VDDA_12	VDDA_12	VDDA_12	VSS		DFT_GPIO0	DFT_GPIO1		VDD_CORE		VDDR3	LVSSR	
E	GFX_CLKN	VDDA_12	VDDA_12	VSS		VDDA_12	VDD_PLL		VSS		VDDR3	LVDS_DIGON	
F	VSSA	GFX_CLKP	VSSA	VDDA_12			VDD_PLL		VSS_PLL		VSS	LVDS_BLEN	
G	SB_CLKP	SB_CLKN	VSSA	GFX_RX0N	GFX_RX0P	VSSA	VDDA_12		VSS_PLL		VSS	LVDS_BLON	
H	VSSA	GFX_TX0N	VSSA								VDD_CORE	VSS	
J	GFX_TX0P	VSSA	VSSA	GFX_RX2P	GFX_RX2N	VSSA	GFX_RX1N	GFX_RX1P			VDD_CORE	VSS	
K	GFX_TX1N	GFX_TX1P	GFX_TX2P										
L	GFX_TX3P	GFX_TX3N	GFX_TX2N	GFX_RX4P	GFX_RX4N	VSSA	GFX_RX3N	GFX_RX3P	VDDA_12		VDD_CORE	VSS	VDD_CORE
M	VDDA_12_PKG	VSSA	VSSA	GFX_RX6P	GFX_RX6N	VSSA	GFX_RX5N	GFX_RX5P	VDDA_12		VSS	VDD_CORE	VSS
N	GFX_TX4N	GFX_TX4P	VSSA								VDD_CORE	VSS	VDD_CORE
P	GFX_TX5N	GFX_TX5P	GFX_TX6P	GPP_RX2P	GPP_RX2N	VSSA	GFX_RX7N	GFX_RX7P	VSSA		VSS	VDD_CORE	VSS
R	GFX_TX7P	GFX_TX7N	GFX_TX6N	GPP_RX3P	GPP_RX3N	VSSA	GPP_RX0P	GPP_RX0N	VSSA		VDD_CORE	VSS	VDD_CORE
T	VSSA	VSSA	VSSA										
U	GPP_TX2N	GPP_TX2P	VSSA	GPP_RX1P	GPP_RX1N	VSSA	VDDA_12				VDD_CORE	VDD_CORE	
V	GPP_TX3N	GPP_TX3P	GPP_TX0P						SB_RX1P		VSS	MEM_CS#	
W	GPP_TX1P	GPP_TX1N	GPP_TX0N	SB_RX3P	SB_RX3N	VSSA	VDDA_12		SB_RX1N		MEM_COMPN	MEM_A0	
Y	VSSA	SB_TX3P	SB_TX3N	SB_RX2P	SB_RX2N		VSSA		MEM_ODT		MEM_COMP	VSS	
AA	SB_TX2P	SB_TX2N	VSSA				VSSA		VDD_MEM		MEM_A13	MEM_A8	
AB	SB_TX1P	SB_TX1N	VDDA_12	VDDA_12		SB_RX0N	SB_RX0P		VDD_MEM		MEM_A3	MEM_A2	
AC	SB_TX0P	SB_TX0N	VDDA_12	NC	VDDA_12	VSSA	VDD_MEM	VDD_MEM	MEM_A9	VSS	MEM_BA0	VSS	MEM_DQ2
AD	VSSA	VDDA_12	VDDA_12_PKG	NC	THERMALDIODE_P	VDD_MEM	VDD_MEM	VDD_MEM	MEM_A12	MEM_A1	MEM_BA2	MEM_CKE	MEM_DQ0
AE	VSSA	VDDA_12	PCE_CALRN	PCE_CALRP	THERMALDIODE_N	VDD_MEM	VDD_MEM	VDD_MEM	MEM_A7	MEM_A10	MEM_BA1	MEM_VREF	MEM_DQ1
	1	2	3	4	5	6	7	8	9	10	11	12	13

	CPU Interface
	A-Link Express interface
	Clock Interface
	Side-port Memory
	CRT and TV Interface
	External graphics Interface
	LVDS Interface
	General Purpose External Device Interface
	Power Management Interface
	Powers
	Grounds
	Others

Figure 3-1 M690T Pin Assignment (Left)

14	15	16	17	18	19	20	21	22	23	24	25	
LVSSR	TXOUT_U0P	LVSSR	TXOUT_U2N	TXOUT_U3P	VDD_CORE	AVDDDI	AVDDQ	AVSSQ	VSS	HT_RXCALP	VSS	A
TXOUT_L0P	TXOUT_L0N	TXOUT_U0N	TXOUT_U2P	TXOUT_U3N	VDD_CORE	AVSSDI	RSET	AVDD	HTREFCLK	HTPVDD	HTPVSS	B
TMDS_HPD	LVSSR	LVSSR	TXOUT_U1P	TXOUT_U1N	LVSSR	Y	C	AVDD	HTSTCLK	HT_RXCALN	HT_TXCALP	C
LPVDD	TXCLK_LN		TXOUT_L3P		COMP	VDD_CORE		VDD_HT_PKG	VSS	HT_TXCALN	VSS	D
LPVSS	TXCLK_LP		TXOUT_L3N		RED				HT_TXCAD1P	HT_TXCAD0P	HT_TXCAD0N	E
LVSSR	LVSSR		VSS		GREEN		HT_TXCAD8P	HT_TXCAD8N	HT_TXCAD1N	HT_TXCAD2N	HT_TXCAD2P	F
TXOUT_L2N	TXCLK_UN		AVSSN		BLUE	VDD_CORE	HT_TXCAD10N	HT_TXCAD10P	VSS	VSS	HT_TXCAD3P	G
TXOUT_L2P	TXCLK_UP		AVSSN						VSS	HT_TXCAD3N	VSS	H
VDD_18	VDD_18				VDD_CORE	HT_TXCAD9P	HT_TXCAD9N	VSS	HT_TXCAD4P	HT_TXCLK0P	HT_TXCLK0N	J
									HT_TXCAD4N	HT_TXCAD5N	HT_TXCAD5P	K
VSS	VDD_CORE		VDD_CORE	HT_TXCAD11P	HT_TXCAD11N	VSS	HT_TXCLK1P	HT_TXCLK1N	VSS	VSS	HT_TXCAD6P	L
VDD_CORE	VSS		VSS	HT_TXCAD12P	HT_TXCAD12N	VSS	HT_TXCAD13N	HT_TXCAD13P	VSS	HT_TXCAD6N	VSS	M
VSS	VDD_CORE								HT_TXCTLN	HT_TXCAD7P	HT_TXCAD7N	N
VDD_CORE	VSS		VDD_CORE	HT_TXCAD14P	HT_TXCAD14N	VSS	HT_TXCAD15P	HT_TXCAD15N	HT_TXCTLN	HT_RXCTLN	HT_RXCTLN	P
VSS	VDD_CORE		VSS	HT_RXCAD15N	HT_RXCAD15P	VSS	HT_RXCAD14P	HT_RXCAD14N	VSS	VSS	HT_RXCAD7N	R
									VSS	HT_RXCAD7P	VSS	T
VDD_CORE	VDD_CORE			HT_RXCAD12P	HT_RXCAD12N	VSS	HT_RXCAD13N	HT_RXCAD13P	HT_RXCAD5N	HT_RXCAD6N	HT_RXCAD6P	U
VSS	MEM_CKN								HT_RXCAD5P	HT_RXCAD4P	HT_RXCAD4N	V
MEM_A4	MEM_CKP		VSS		HT_RXCAD11P	HT_RXCAD11N	HT_RXCLK1P	HT_RXCLK1N	VSS	VSS	HT_RXCLK0N	W
MEM_A11	MEM_CAS#		IOPLLSS		HT_RXCAD8N			VSS	VSS	HT_RXCLK0P	VSS	Y
VSS	MEM_RAS#		IOPLLVD18		HT_RXCAD8P	HT_RXCAD9N			HT_RXCAD2N	HT_RXCAD3N	HT_RXCAD3P	AA
MEM_A6	MEM_A5		IOPLLVD12		VSS	HT_RXCAD9P		HT_RXCAD10N	HT_RXCAD2P	HT_RXCAD1P	HT_RXCAD1N	AB
MEM_WE#	MEM_DQ4	MEM_DM0	MEM_DQ9	VSS	MEM_DQ12	MEM_DQ51N	HT_RXCAD10P	VSS	VSS	HT_RXCAD0P	HT_RXCAD0N	AC
MEM_DQ3	MEM_DQ5	MEM_DQ8	MEM_DQ50N	MEM_DQ10	MEM_DM1	MEM_DQ14	MEM_DQ51P	VDD_HT	VDD_HT	VDD_HT	VSS	AD
VSS	MEM_DQ6	MEM_DQ7	MEM_DQ50P	VSS	MEM_DQ11	MEM_DQ13	MEM_DQ15	VDD_HT	VDD_HT	VDD_HT	VDD_HT	AE
14	15	16	17	18	19	20	21	22	23	24	25	

	CPU Interface
	A-Link Express interface
	Clock Interface
	Side-port Memory
	CRT and TV Interface
	External graphics Interface
	LVDS Interface
	General Purpose External Device Interface
	Power Management Interface
	Powers
	Grounds
	Others

Figure 3-2 M690T Pin Assignment (Right)

## 3.2 Interface Block Diagram

The figure below shows the different interfaces on the M690T. Interface names in [blue](#) are hyperlinks to the corresponding sections in this chapter.

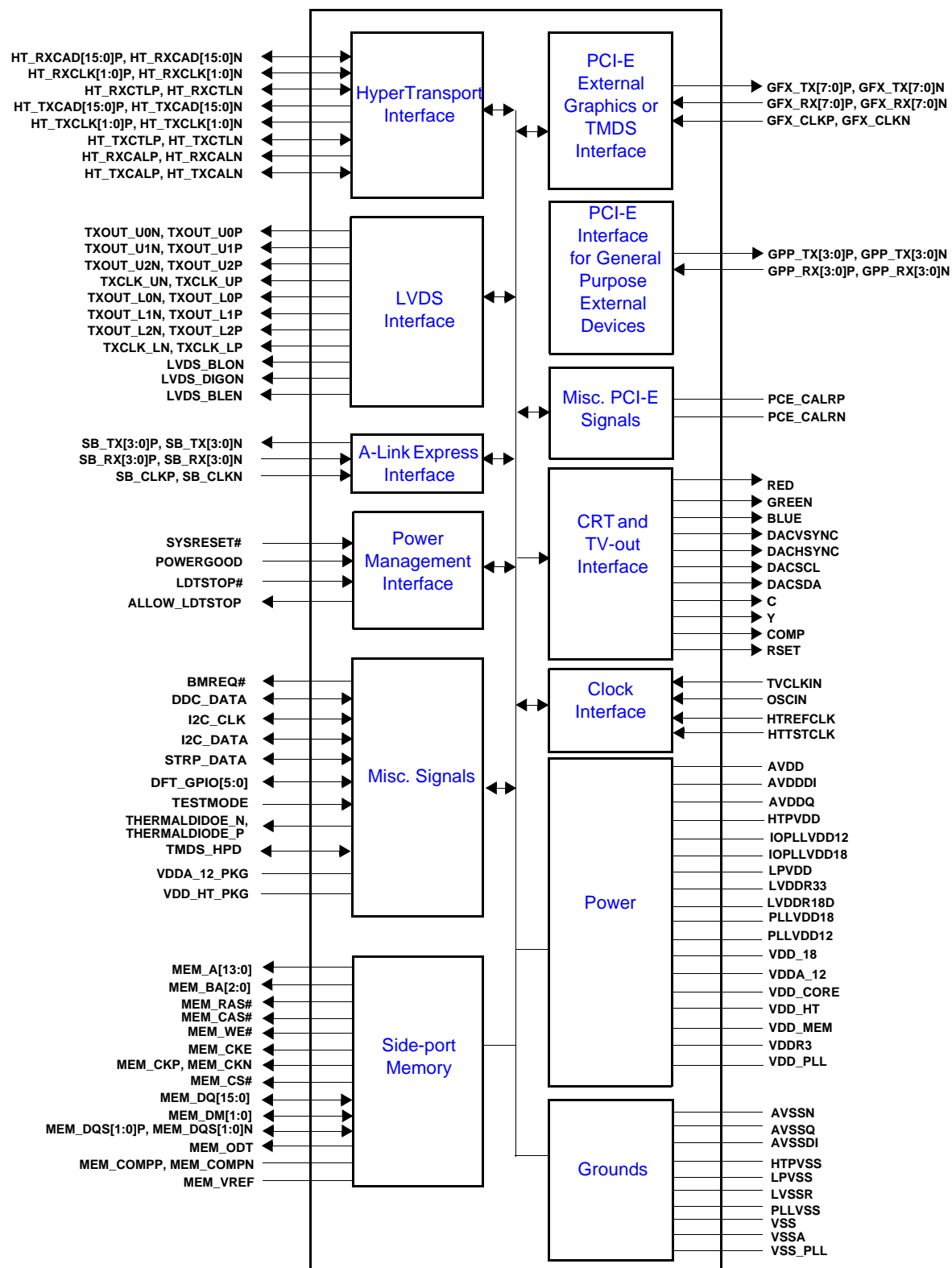


Figure 3-3 M690T Interface Block Diagram



### 3.3 CPU HyperTransport™ Interface

Table 3-1 CPU HyperTransport™ Interface

Pin Name	Type	Power Domain	Ground Domain	Functional Description
HT_RXCAD[15:0]P, HT_RXCAD[15:0]N	I	VDDHT	VSS	Receiver Command, Address, and Data Differential Pairs
HT_RXCLK[1:0]P, HT_RXCLK[1:0]N	I	VDDHT	VSS	Receiver Clock Signal Differential Pair. Forwarded clock signal. Each byte of RXCAD uses a different clock signal. Data is transferred on each clock edge.
HT_RXCTLN, HT_RXCTLN	I	VDDHT	VSS	Receiver Control Differential Pair. For distinguishing control packets from data packets.
HT_TXCAD[15:0]P, HT_TXCAD[15:0]N	O	VDDHT	VSS	Transmitter Command, Address, and Data Differential Pairs
HT_TXCLK[1:0]P, HT_TXCLK[1:0]N	O	VDDHT	VSS	Transmitter Clock Signal Differential Pair. Each byte of TXCAD uses a different clock signal. Data is transferred on each clock edge.
HT_TXCTLN, HT_TXCTLN	O	VDDHT	VSS	Transmitter Control Differential Pair. Forwarded clock signal. For distinguishing control packets from data packets.
HT_RXCALN	Other	VDDHT	VSS	Receiver Calibration Resistor to VDD_HT power rail.
HT_RXCALP	Other	VDDHT	VSS	Receiver Calibration Resistor to Ground
HT_TXCALP	Other	VDDHT	VSS	Transmitter Calibration Resistor to HTTX_CALN
HT_TXCALN	Other	VDDHT	VSS	Transmitter Calibration Resistor to HTTX_CALP

### 3.4 DDR2 Side-port Memory Interface

Table 3-2 DDR2 Side-port Memory Interface

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
MEM_A[13:0]	O	VDD_MEM	VSS	None	Memory Address Bus. Provides the multiplexed row and column addresses to the memories.
MEM_BA[2:0]	O	VDD_MEM	VSS	None	Memory Bank Address
MEM_RAS#	O	VDD_MEM	VSS	None	Row Address Strobe
MEM_CAS#	O	VDD_MEM	VSS	None	Column Address Strobe
MEM_WE#	O	VDD_MEM	VSS	None	Write Enable Strobe
MEM_CKE	O	VDD_MEM	VSS	None	Clock Enable
MEM_CKP	O	VDD_MEM	VSS	None	Memory Differential Positive Clock
MEM_CKN	O	VDD_MEM	VSS	None	Memory Differential Negative Clock
MEM_CS#	O	VDD_MEM	VSS	None	Chip Select
MEM_ODT	O	VDD_MEM	VSS	None	On-die Termination
MEM_DQ[15:0]	I/O	VDD_MEM	VSS	None	Memory Data Bus. Supports SSTL2 and SSTL3.
MEM_DM[1:0]	I/O	VDD_MEM	VSS	None	Data masks for each byte during memory write cycles
MEM_DQS[1:0]P	I/O	VDD_MEM	VSS	None	Memory Data Strobes. These are bi-directional data strobes for latching read/write data.
MEM_DQS[1:0]N	I/O	VDD_MEM	VSS	None	Do not connect.
MEM_COMPP, MEM_COMPN	Other	VDD_MEM	VSS	None	Memory interface compensation pins for N and P channel devices. Connect through resistors to VDD_MEM and ground respectively (refer to the reference schematics for the proper resistor values).
MEM_VREF	Other	—	VSS	None	Reference voltage. It supplies the threshold value for distinguishing between “1” and “0” on a memory signal. Typical value is 0.5*VDD_MEM.

### 3.5 PCI Express® Interfaces

#### 3.5.1 1 x 8 Lane Interface for External Graphics

**Table 3-3 1 x 8 Lane PCI Express® Interface for External Graphics**

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
GFX_TX[7:0]P, GFX_TX[7:0]N	O	VDD_PCIE	VSS_PCIE	50Ω between complements	Transmit Data Differential Pairs. Connect to external connector for an external graphics card on the motherboard (if implemented).
GFX_RX[7:0]P, GFX_RX[7:0]N	I	VDD_PCIE	VSS_PCIE	50Ω between complements	Receive Data Differential Pairs. Connect to external connector for an external graphics card on the motherboard (if implemented).
GFX_REFCLKP, GFX_REFCLKN	I	VDD_PCIE	VSS_PCIE	50Ω between complements	Clock Differential Pairs. Connect to external clock generator when an external graphics card is implemented.

#### 3.5.2 A-Link Express II to Southbridge

**Table 3-4 1 x 4 Lane A-Link Express II Interface for Southbridge**

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
SB_TX[3:0]P, SB_TX[3:0]N	O	VDD_PCIE	VSS_PCIE	50Ω between complements	Transmit Data Differential Pairs. Connect to the corresponding Receive Data Differential pairs on the Southbridge.
SB_RX[3:0]P, SB_RX[3:0]N	I	VDD_PCIE	VSS_PCIE	50Ω between complements	Receive Data Differential Pairs. Connect to the corresponding Transmit Data Differential pairs on the Southbridge.
SB_CLKP, SB_CLKN	I	VDD_PCIE	VSS_PCIE	50Ω between complements	Clock Differential Pair. Connect to an external clock generator on the motherboard.

#### 3.5.3 4 x 1 Lane Interface for General Purpose External Devices

**Table 3-5 4 x 1 Lane PCI Express® Interface for General Purpose External Devices**

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
GPP_TX[3:0]P, GPP_TX[3:0]N	O	VDD_PCIE	VSS_PCIE	50Ω between complements	Transmit Data Differential Pairs. Connect to external connectors on the motherboard for add-in card or ExpressCard support.
GPP_RX[3:0]P, GPP_RX[3:0]N	I	VDD_PCIE	VSS_PCIE	50Ω between complements	Receive Data Differential Pairs. Connect to external connectors on the motherboard for add-in card or ExpressCard support.

#### 3.5.4 Miscellaneous PCI Express® Signals

**Table 3-6 PCI Express® Interface for Miscellaneous PCI Express® Signals**

Pin Name	Type	Power Domain	Ground Domain	Functional Description
PCE_CALRN	Other	VDD_PCIE	VSS_PCIE	RX Impedance Calibration. Connect to VDD_PCIE on the motherboard with an external resistor of an appropriate value.
PCE_CALRP	Other	VDD_PCIE	VSS_PCIE	TX Impedance Calibration. Connect to GND on the motherboard with an external resistor of an appropriate value.

### 3.6 Clock Interface

**Table 3-7 Clock Interface**

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
TVCLKIN	I	VDDR3	VSS	–	Input pin for reference clock for external TV-out support (3.3V signaling). SUS_STAT# from the SB can be connected to this signal for putting the side-port memory into self-refresh before a system warm reset; that would allow a more graceful reset of the side-port memory interface.
HTREFCLK	I	HTPVDD	HTPVSS	-	HyperTransport 66MHz reference clock from external clock source
HTTSTCLK	I	HTPVDD	HTPVSS	-	HyperTransport Bus Test Clock. Drives test clock in test mode. Connect to ground in functional mode.
GFX_REFCLKP, GFX_REFCLKN	I	VDDPCIE	VSSAPCIE	50 $\Omega$ between complements	Clock Differential Pairs for external graphics. Connect to external clock generator when an external graphics card is implemented.
SB_CLKP, SB_CLKN	I	VDDPCIE	VSSAPCIE	50 $\Omega$ between complements	Clock Differential Pair for the Southbridge and general purpose PCI Express® (PCI-E) devices. Connect to an external clock generator on the motherboard.
OSCIN	I	VDDR3	VSS	Disabled	14.31818MHz Reference clock input from the External Clock chip (3.3 volt signaling).

### 3.7 CRT and TV Interface

**Table 3-8 CRT and TV Interface**

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
RED	A-O	AVDD	AVSSN	–	Red for CRT monitor output, Cr or Pr for component video TV output
GREEN	A-O	AVDD	AVSSN	–	Green for CRT monitor output, or Y for component video TV output
BLUE	A-O	AVDD	AVSSN	–	Blue for CRT monitor output, Cb or Pb for component video TV output
Y	A-O	AVDD	AVSSN	–	SVID luminance output for TV out, or Y for component video TV output
C	A-O	AVDD	AVSSN	–	SVID chrominance output for TV out, or Pr for component video TV output
COMP	A-O	AVDD	AVSSN	–	Composite video TV output, or Pb for component video TV output
DACHSYNC	A-O	VDDR3	VSS	50k $\Omega$ programmable: PU/PD/none	Display Horizontal Sync
DACVSYNC	A-O	VDDR3	VSS	50k $\Omega$ programmable: PU/PD/none	Display Vertical Sync
RSET	Other	N/A	AVSSQ	–	DAC internal reference to set full scale DAC current through 1% resistor to AVSS
DACSDA	I/O	VDDR3	VSS	50k $\Omega$ programmable: PU/PD/none	I <sup>2</sup> C Data for display (to video monitor)
DACSCL	I/O	VDDR3	VSS	50k $\Omega$ programmable: PU/PD/none	I <sup>2</sup> C Clock for display (to video monitor)

### 3.8 LVDS Interface (24 Bits)

**Note:** For designs implementing only a single LVDS channel, the LOWER channel of the interface should be used.

**Table 3-9 LVDS Interface**

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
TXOUT_U0N	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper data channel 0 (-). Only used in dual-channel LVDS mode.
TXOUT_U0P	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper data channel 0 (+). Only used in dual-channel LVDS mode.
TXOUT_U1N	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper data channel 1 (-). Only used in dual-channel LVDS mode.
TXOUT_U1P	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper data channel 1 (+). Only used in dual-channel LVDS mode.
TXOUT_U2N	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper data channel 2 (-). Only used in dual-channel LVDS mode.
TXOUT_U2P	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper data channel 2 (+). Only used in dual-channel LVDS mode.
TXOUT_U3N	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper data channel 3 (-). Only used in dual-channel LVDS mode.
TXOUT_U3P	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper data channel 3 (+). Only used in dual-channel LVDS mode.
TXCLK_UN	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper clock channel (-). Only used in dual-channel LVDS mode.
TXCLK_UP	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS upper clock channel (+). Only used in dual-channel LVDS mode.
TXOUT_L0N	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower data channel 0 (-). This channel is used as the transmitting channel in single-channel LVDS mode.
TXOUT_L0P	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower data channel 0 (+). This channel is used as the transmitting channel in single-channel LVDS mode.
TXOUT_L1N	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower data channel 1 (-). This channel is used as the transmitting channel in single-channel LVDS mode.
TXOUT_L1P	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower data channel 1 (+). This channel is used as the transmitting channel in single-channel LVDS mode.
TXOUT_L2N	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower data channel 2 (-). This channel is used as the transmitting channel in single-channel LVDS mode.
TXOUT_L2P	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower data channel 2 (+). This channel is used as the transmitting channel in single-channel LVDS mode.
TXOUT_L3N	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower data channel 3 (-). This channel is used as the transmitting channel in single-channel LVDS mode.
TXOUT_L3P	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower data channel 3 (+). This channel is used as the transmitting channel in single-channel LVDS mode.
TXCLK_LN	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower clock channel (-). This channel is used as the transmitting channel in single-channel LVDS mode.
TXCLK_LP	O	LVDDR33 LVDDR18D	LVSSR	None	LVDS lower clock channel (+). This channel is used as the transmitting channel in single-channel LVDS mode.

Table 3-9 LVDS Interface (Continued)

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
LVDS_BLON	I/O	VDDR3	VSS	50kΩ programmable: PU/PD/none	Digital panel backlight brightness control. Active high. It controls backlight on/off or acts as PWM output to adjust brightness. If LVTMA_BL_MOD_CNTL.LVTMA_BL_MOD_EN = 0, the pin controls backlight on/off. Otherwise, it is the PWM output to adjust the brightness. LVTMA_BL_MOD_CNTL.LVTMA_BL_MOD_LEVEL can be used to control the backlight level (256 steps) by means of pulse width modulation. The duty cycle of the backlight signal can be set through the LVTMA_BL_MOD_CNTL.LVTMA_BL_MOD_LEVEL bits. For example, setting these bits to a value of 32 will set the on-time to $32/256 \times (1/f)$ and the off-time to $(256-32)/256 \times (1/f)$ , where f is the XTALIN frequency and is typically 14.318MHz. Note that the PWM frequency is set by LVTMA_BL_MOD_CNTL.LVTMA_BL_MOD_RES and LVTMA_PWRSEQ_REF_DIV.LVTMA_BL_MOD_REF_DIV. The PWM frequency = $f / ((BL\_MOD\_REF\_DIV+1) \times (BL\_MOD\_RES+1))$ . For more information, refer to the Register Reference Manual. In CPIS mode, LVDS_BLON is VARY_BL as defined in CPIS. PWM mode should be enabled. LVDS_BLEN should be connected to ENA_BL, which turns the backlight AC inverter on/off.
LVDS_DIGON	I/O	VDDR3	VSS	50kΩ programmable: PU/PD/none	Control Panel Digital Power On/Off. Active high.
LVDS_BLEN	I/O	VDDR3	VSS	50kΩ programmable: PU/PD/none	Enables Backlight for CPIS compliant LCD panels. Active high. Controlled by the hardware power up/down sequencer. For more details, refer to <a href="#">Figure 4-2, “LCD Panel Power Up/Down Timing,” on page 4- 5</a> .

### 3.9 TMDS Interface Multiplexed on the PCI Express® Graphics Lanes

The M690T supports a dual-link TMDS interface, enabling DVI/HDMI, which is multiplexed on the PCI-E external graphics lanes. The TMDS interface is available only if no external graphics card is attached to the PCI-E graphics interface.

HDMI is enabled only through the single-link mode. [Table 3-10, “TMDS Interface Multiplexed on the PCI Express® Graphics Interface,”](#) shows the multiplexing relationships between the PCI-E external graphics signals and the TMDS signals.

Table 3-10 TMDS Interface Multiplexed on the PCI Express® Graphics Interface

Pin Name	Ball Reference	TMDS Function
GFX_TX0P	J1	TX2P - 1st Link Red+
GFX_TX0N	H2	TX2M - 1st Link Red-
GFX_TX1P	K2	TX1P - 1st Link Green+
GFX_TX1N	K1	TX1M - 1st Link Green-
GFX_TX2P	K3	TX0P - 1st Link Blue+
GFX_TX2N	L3	TX0M - 1st Link Blue -
GFX_TX3P	L1	TXCP - Clock+
GFX_TX3N	L2	TXCM - Clock-
GFX_TX4P	N2	TX5P - 2nd Link Red+
GFX_TX4N	N1	TX5M - 2nd Link Red-
GFX_TX5P	P2	TX4P - 2nd Link Green+

Table 3-10 TMDS Interface Multiplexed on the PCI Express® Graphics Interface (Continued)

Pin Name	Ball Reference	TMDS Function
GFX_TX5N	P1	TX4M - 2nd Link Green-
GFX_TX6P	P3	TX3P - 2nd Link Blue+
GFX_TX6N	R3	TX3M - 2nd Link Blue-

### 3.10 Power Management Pins

Table 3-11 Power Management Pins

Pin Name	Type	Power Domain	Ground Domain	Functional Description
LDTSTOP#	I	VDDR3	VSS	HyperTransport Stop. Input from the Southbridge to enable and disable the HyperTransport link during system state transitions. For systems requiring power management. Single-ended.
ALLOW_LDTSTOP	OD	VDDR3	VSS	Output going to the Southbridge to allow LDTSTOP assertions: 1 = LDTSTOP# can be asserted 0 = LDTSTOP# has to be de-asserted
SYSRESET#	I	VDDR3	VSS	Global Hardware Reset. This signal comes from the Southbridge.
POWERGOOD	I	VDDR3	VSS	Input from the motherboard signifying that the power to the M690T is up and ready. Signal high means all power planes are valid. It is not observed internally until it has been high for more than 6 consecutive REFCLK cycles. The rising edge of this signal is deglitched. The nominal input high voltage is 3.3V.

### 3.11 Miscellaneous Pins

Table 3-12 Miscellaneous Pins

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
BMREQ#	O	VDDR3	VSS	–	This output signal to the Southbridge indicates that there is a DMA request from a PCI Express Bus device. The signal is not used on the M690T platforms and should be left unconnected.
DFT_GPIO[5:0]	I/O	VDD_18	VSS	–	GPIO for DFT purpose.
I2C_CLK	I/O	VDDR3	VSS	50kΩ programmable: PU/PD/none	I <sup>2</sup> C interface clock signal. Can also be used simultaneously as DDC interface clock for more than one display. It can also be used as GPIO.
I2C_DATA	I/O	VDDR3	VSS	50kΩ programmable: PU/PD/none	I <sup>2</sup> C interface data signal. It can also be used as GPIO.
DDC_DATA	I/O	VDDR3	VSS	50kΩ programmable: PU/PD/none	Pin for additional DDC data channel for displays. It makes use of I2C_CLK to create an I <sup>2</sup> C interface. Can also be used as GPIO.
STRP_DATA	I/O	VDDR3	VSS	50kΩ programmable: PU/PD/none	I2C interface data signal for external EEPROM based strap loading. Can also be used as GPIO, or as output to the voltage regulator for pulse-width modulation of M690T's core voltage.
TESTMODE	I	VDDR3	VSS	–	When high, puts the M690T in test mode and disables the M690T from operating normally.
THERMALDIODE_P, THERMALDIODE_N	A-O	–	–	–	Diode connections to external SMBus microcontroller for monitoring IC thermal characteristics.
TMD5_HPD	I/O	VDDR3	VSS	50kΩ programmable: PU/PD/none	TMD5 Hot Plug Detect. It monitors the hot-plug line for panel detection. It is a 3.3V CMOS compatible input. When not used for hot plug detection, it can also be used as output to the voltage regulator for pulse-width modulation of various voltages on the motherboard.

Table 3-12 Miscellaneous Pins (Continued)

Pin Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
VDD_HT_PKG	Other	VDD_HT	VSS	–	The pin is for connecting a calibration resistor to the VDD_HT power plane. The VDD_HT_PKG pin is connected to the VDD_HT power pins via package routing, so that a calibration resistor for the VDD_HT power plane can be connected to the M690T through the VDD_HT_PKG pin, and the VDD_HT power plane does not have to be extended physically for the purpose.
VDDA_12_PKG	Other	VDDA_12	VSS	–	The pins are for connecting calibration resistors to the VDDA_12 power plane. VDDA_12_PKG pins are connected to the VDDA_12 power pins via package routing, so that the calibration resistors for the VDDA_12 power plane can be connected to the M690T through the VDDA_12_PKG pins, and the VDDA_12 power plane does not have to be extended physically for the purpose.

## 3.12 Power Pins

Table 3-13 Power Pins

Pin Name	Voltage	Pin Count	Ball Reference	Comments
AVDD	2.5V or 3.3V	2	B22, C22	Dedicated power for the DAC. Effort should be made at the board level to provide as clean a power as possible to this pin to avoid noise injection, which can affect display quality. Adequate decoupling should be provided between this pin and AVSS.
AVDDQ	1.8V	1	A21	DAC Bandgap Reference Voltage
AVDDDI	1.8V	1	A20	Dedicated digital power for the DAC
VDD_CORE	1.0-1.2V	32	A19, A4, A7, A9, B19, B9, C9, D20, D9, G20, H11, J11, J19, L11, L13, L15, L17, M12, M14, N11, N13, N15, P12, P14, P17, R11, R13, R15, U11, U12, U14, U15	Core power
VDD_18	1.8V	2	J14, J15	Core transform power for GPIOs and power for DFT_GPIOs
VDDA_12	1.2 V	20	AB3, AB4, AC3, AC5, AD2, AE2, B1, C1, D1, D2, D3, E2, E3, E6, F4, G7, L9, M9, U7, W7	PCI-E interface main I/O power
VDD_HT	1.2V	7	AAD22, AD23, AD24, AE22, AE23, AE24, AE25	I/O power for HyperTransport interface
VDD_MEM	1.8V	10	AA9, AB9, AC7, AC8, AD6, AD7, AD8, AE6, AE7, AE8	Isolated power for side-port memory and debug I/Os
VDDR3	3.3V	2	D11, E11	I/O power for the following I/O pads: POWERGOOD, SYSRESET#
VDD_PLL	1.2V	2	E7, F7	PCI-E interface PLL power
IOPLLVD12	1.2V	1	AB17	1.2V power for memory I/O PLLs
IOPLLVD18	1.8V	1	AA17	1.8V power for memory I/O PLLs
LPVDD	1.8V	1	D14	Power for LVDS PLL macro.
LVDDR18D	1.8V	2	A12, B12	1.8V LVDS Digital Power, used for the digital portions of the LVDS transmitter
LVDDR33	3.3V	2	C12, C13	3.3V LVDS Analog Power, used for the output stage of the transmitter. This power supply needs to be adequately filtered to prevent noise injection.
PLLVD18	1.8V	1	A10	1.8V power for system PLLs
PLLVD12	1.2V	1	A11	1.2V power for system PLLs



Table 3-13 Power Pins (Continued)

Pin Name	Voltage	Pin Count	Ball Reference	Comments
HTPVDD	1.8V	1	B24	Power for HyperTransport interface PLL
Total Power Pin Count		89		

### 3.13 Ground Pins

Table 3-14 Ground Pins

Pin Name	Pin Count	Ball Reference	Comments
AVSSN	2	G17, H17	Dedicated analog ground for the DAC
AVSSQ	1	A22	Dedicated ground for the Band Gap Reference. Effort should be made at the board level to provide as clean a ground as possible to this pin to avoid noise injection, which can affect display quality. Adequate decoupling should be provided between this pin and AVDD.
AVSSDI	1	B20	Dedicated digital ground for the DAC (1.8V)
IOPLLVSS	1	Y17	Ground for system PLLs
LPVSS	1	E14	LVDS PLL macro ground pin
LVSSR	8	A14, A16, C15, C16, C19, D12, F14, F15	LVDS interface ground pin
VSS	64	A23, A25, AA14, AB19, AC10, AC12, AC18, AC22, AC23, AD25, AE14, AE18, B7, C4, D23, D25, D4, E9, F11, F17, G11, G23, G24, H12, H23, H25, J12, J22, L12, L14, L20, L23, L24, M11, M13, M15, M17, M20, M23, M25, N12, N14, P11, P13, P15, P20, R12, R14, R17, R20, R23, R24, T23, T25, U20, V11, V14, W17, W23, W24, Y12, Y22, Y23, Y25	Common ground
VSSA	32	A1, AA3, AA7, AC6, AD1, AE1, F1, F3, G3, G6, H1, H3, J2, J3, J6, L6, M2, M3, M6, N3, P6, P9, R6, R9, T1, T2, T3, U3, U6, W6, Y1, Y7	PCI Express interface ground
VSS_PLL	2	F9, G9	Ground pin for PCI-E interface PLL
PLLVSS	1	B10	Ground pin for graphics core PLL
HTPVSS	1	B25	Ground pin for HyperTransport interface PLL
Total Ground Pin Count		114	

### 3.14 Debug Port Signals

In order to fully support debugging of customer platforms, it is **mandatory** that customer designs allow access to the signals listed in [Table 3-15, “M690T Debug Port Signals”](#) below.

For debug ports on the side-port memory signals, an acceptable implementation of an access point will be an opening in the solder mask for the required signal traces. Adding stubs to side-port memory signals for the purpose is not recommended. Other signals in the table should be brought out to test points on the motherboard.



**Table 3-15 M690T Debug Port Signals**

Pin Name	Ball Ref	Debug Port Name
MEM_A0	W12	Debug0
MEM_A1	AD10	Debug1
MEM_A2	AB12	Debug2
MEM_A3	AB11	Debug3
MEM_A4	W14	Debug4
MEM_A5	AB15	Debug5
MEM_A6	AB14	Debug6
MEM_A7	AE9	Debug7
MEM_A8	AA12	Debug8
MEM_A9	AC9	Debug9
MEM_A10	AE10	Debug10
MEM_A11	Y14	Debug11
MEM_A12	AD9	Debug12
MEM_A13	AA11	Debug13
MEM_BA0	AC11	Debug14
MEM_BA1	AE11	Debug15
DFT_GPIO2	C8	Debug [programmable*]
DFT_GPIO3	C7	Debug [programmable*]
DFT_GPIO4	B8	Debug [programmable*]
DFT_GPIO5	A8	Debug [programmable*]
LVDS_BLON	G12	Debug [programmable*]
LVDS_BLEN	F12	Debug [programmable*]
LVDS_DIGON	E12	Debug [programmable*]
TMD5_HPD	C14	Debug [programmable*]

\*Note: The port is programmable into any of Debug0 to Debug15.

### 3.15 Strapping Options

The M690T provides strapping options to define specific operating parameters. The strap values are latched into internal registers after the assertion of the POWERGOOD signal to the M690T. [Table 3-16, “Strap Definitions for the M690T,”](#) shows the definitions of all the strap functions. These straps are set by one of the following four methods:

- Allowing the internal pull-up resistors to set all strap values to “1” automatically.
- Attaching pull-down resistors to specific strap pins listed in [Table 3-16](#) to set their values to “0”.
- Downloading the strap values from an I<sup>2</sup>C serial EEPROM (for debug purpose only; contact your AMD CSS representative for details).
- Setting through an external debug port, if implemented (contact your AMD CSS representative for details).

All of the straps below are defined active low. They are pulled up internally by default, so that no external pull-ups are required to select “1”s for those straps. To select “0”s, the strap pins must be pulled down to VSS through resistors. During reset, the strap pins are undriven, allowing either an internal pull-up to pull a pin to “1” or an external pull-down to pull a pin to “0.” The values on the strap pins are then latched into the device and used as operational parameters. However, for debug purposes, those latched values may be overridden through an external debug strap port or by a bit-stream downloaded from a serial EEPROM.

Table 3-16 Strap Definitions for the M690T

Strap Function	Strap Pin	Description
STRAP_DEBUG_BUS_EN#	DFT_GPIO5	Enables debug bus output via the memory I/O pads. 0: Use the memory data bus for debug bus output <b>1: Use default values (Default)</b> (See debug bus specification documents for more details.)
GPPSB_LINK_CONFIG	DFT_GPIO[4:2]	Southbridge and General Purpose Link Configuration. See <a href="#">Table 3-17</a> below for details.
LOAD_ROM_STRAPS#	DFT_GPIO1	Selects loading of strap values from EEPROM 0: I <sup>2</sup> C master can load strap values from EEPROM if connected, or use default values if not connected <b>1: Use default values (Default)</b>

Table 3-17 Strap Definition for GPPSB\_LINK\_CONFIG

Strap Pin Value			Link Width					Configuration
DFT_GPIO4	DFT_GPIO3	DFT_GPIO2	SB	GPP1	GPP2	GPP3	GPP4	
1	1	1	Use register field STRAP_BIF_LINK_CONFIG_GPPSB of register StrapsOutputMux_7 (NBmiscIND: 0x67 bit[7:4]) to define link configuration (Default).					-
1	1	0	4	0	0	0	0	A
1	0	1	4	4	0	0	0	B
1	0	0	4	2	2	0	0	C
0	1	1	4	2	1	1	0	D
0	1	0	4	1	1	1	1	E
Others			Use register field STRAP_BIF_LINK_CONFIG_GPPSB of register StrapsOutputMux_7 (NBmiscIND: 0x67 bit[7:4]) to define link configuration.					-

**Note:** The three strap pins are internally pulled up so that if left unconnected on the motherboard, the M690T will use register field **STRAP\_BIF\_LINK\_CONFIG\_GPPSB** of register **StrapsOutputMux\_7** (NBmiscIND: 0x67 bit[7:4]) to define the link configuration. The power on default value of this register corresponds to Configuration E. If the pin straps are used, the GPPSB configuration will then be determined according to this table and cannot be changed after the system has been powered up.

# Chapter 4

## Timing Specifications

### 4.1 CPU HyperTransport™ Bus Timing

For HyperTransport bus timing information, please refer to CPU specifications.

### 4.2 HyperTransport™ Reference Clock Timing Parameters

**Table 4-1 HTREFCLK Pad (66.66MHz) Timing Parameters**

Symbol	Parameter	Min	Typ	Max	Unit	Comment
TIP	REFCLK Period	–	15	–	ns	Time intervals measured at 50% VDDCK threshold point
FIP	REFCLK Frequency	–	66.66	–	MHz	FIP is the reciprocal of TIP.
TIH	REFCLK High Time	2	–	–	ns	–
TIL	REFCLK Low Time	2	–	–	ns	–
TIR	REFCLK Rise Time	–	–	1.5	ns	–
TIF	REFCLK Fall Time	–	–	1.5	ns	–
TIJCC	REFCLK Cycle-to-Cycle Jitter Requirement	–	–	300	ps	–
TIJLT	REFCLK Long Term Jitter Requirement (1μs after scope trigger)	–	–	1	ns	–

### 4.3 PCI Express® Differential Clock AC Specifications

**Table 4-2 PCI Express® Differential Clock (GFX\_CLK, SB\_CLK) AC Characteristics**

Parameter	Minimum	Maximum	Unit
Absolute Minimum Differential Clock Period	9.872	–	ns
Rise Time	175	700	ps
Fall time	175	700	ps
Rise/Fall Matching	–	20	%
Cycle-to-Cycle Jitter	–	125	ps
Duty Cycle	45	55	%

### 4.4 Side-port Memory Timing

The M690T's side-port memory DDR2 interface complies with all the timing requirements given in the JESD79-2B specification. Please refer to the JEDEC standard for any timing details.

#### 4.4.1 Read Cycle DQ/DQS Delay

During a memory read cycle, there is a DLL inside the M690T that can delay each DQS signal with respect to its byte of the DQ valid window. This delay ensures adequate setup and hold time to capture the memory data. This DLL delay is programmable through the following registers:

MCA\_DLL\_SLAVE\_RD\_0. MCA\_DLL\_ADJ\_DQSR\_0 <NBMCIND : 0xE0[7:0]>

MCA\_DLL\_SLAVE\_RD\_1. MCA\_DLL\_ADJ\_DQSR\_1 <NBMCIND : 0xE1[7:0]>

The fraction of strobe delay, in terms of a memory clock period is  $(24 + \text{MCA\_DLL\_ADJ\_DQSR}) / 240$ . For example: if  $\text{MCA\_DLL\_ADJ\_DQSR}_1 = 36$ , then DQS1 is delayed by  $0.25 \times \text{memory\_clock\_period}$ . So, if the memory clock period is 5ns, then DQS1 is delayed internally by 1.25ns with respect to DQ[15:8].

#### 4.4.2 Write Cycle DQ/DQS Delay

Similar to a read cycle, during memory write cycle there is a DLL inside the M690T that can delay each DQS signal with respect to its byte of the DQ valid window. This delay ensures adequate setup and hold time for DQ and DQS to the memory. This DLL delay is programmable by the following registers in the same manner as with the read cycle:

$\text{MCA\_DLL\_SLAVE\_WR}_0.\text{MCA\_DLL\_ADJ\_DQ\_B0} <\text{NBMCIND} : 0xE8[7:0]>$

$\text{MCA\_DLL\_SLAVE\_WR}_1.\text{MCA\_DLL\_ADJ\_DQ\_B1} <\text{NBMCIND} : 0xE9[7:0]>$

Again, the fraction of strobe delay, in terms of a memory clock period is  $(24 + \text{MCA\_DLL\_ADJ\_DQSR}) / 240$ . For example: if  $\text{MCA\_DLL\_ADJ\_DQ\_B0} = 96$ , then DQS0 is delayed by  $0.5 \times \text{memory\_clock\_period}$ . So, if the memory clock period is 5ns, then DQS0 is delayed internally by 2.5ns with respect to DQ[7:0].

Depending on the board layout of DQS and DQ signals, it may be necessary to have different delays for each DQS signal. Layouts of the DQS and DQ signals should follow the rules given in the *RS690/RS485-Series IGP Motherboard Design Guide*.

## 4.5 LVDS Timing

**Table 4-3 Timing Requirements for the LVDS Interface**

Parameter	Min	Typ	Max	Unit	Notes
Differential Clock Period	11.7	–	40	ns	1
Differential Clock Frequency	25	–	85	MHz	
Frequency of the LVDS PLL VOC	175	–	595	MHz	
Differential Clock Cycle-to-Cycle Jitter	–	–	420	ps	1
Transmitter PLL Reset Time	10	–	–	μs	1,2
Transmitter PLL Lock Time	–	–	750	μs	1,3
Differential Low-to-High Transition Time	0.26	–	$0.3T_b$	ns	4
Differential High-to-Low Transition Time	0.26	–	$0.3T_b$	ns	4
Data Channel to Channel Skew	–	100	–	ps	

**Notes:**

- 1 Time intervals measured at 50% LTPVDD18 threshold point.
- 2 Minimum time to keep LVDS\_PLL\_RESET asserted.
- 3 Measured after LVDS\_PLL\_RESET is de-asserted.
- 4  $T_b$  is the bit-time, which is 1/7 of the differential clock period.

## 4.6 OSCIN Timing

**Table 4-4 Timing Requirements for the OSCIN Pad**

Symbol	Parameter	Min	Typical	Max	Unit	Note
TIP	REFCLK Period	0.037	–	1.1	μs	1
FIP	REFCLK Frequency	0.9	–	27	MHz	2
TIR	REFCLK Rise Time	–	–	1.5	ns	
TIF	REFCLK Fall Time	–	–	1.5	ns	

**Table 4-4 Timing Requirements for the OSCIN Pad (Continued)**

Symbol	Parameter	Min	Typical	Max	Unit	Note
TIJCC	REFCLK Cycle-to-Cycle Jitter Requirement	–	–	300	ps	
FRQD	Frequency Tolerance	–	30	–	ppm	3

**Notes:**

- 1 Time intervals measured at 50% threshold point.
- 2 FIP is the reciprocal of TIP.
- 3 FRQD is the tolerance of the frequency input for proper generation of the expected PLL frequencies.

## 4.7 Power Rail Power Up Sequence

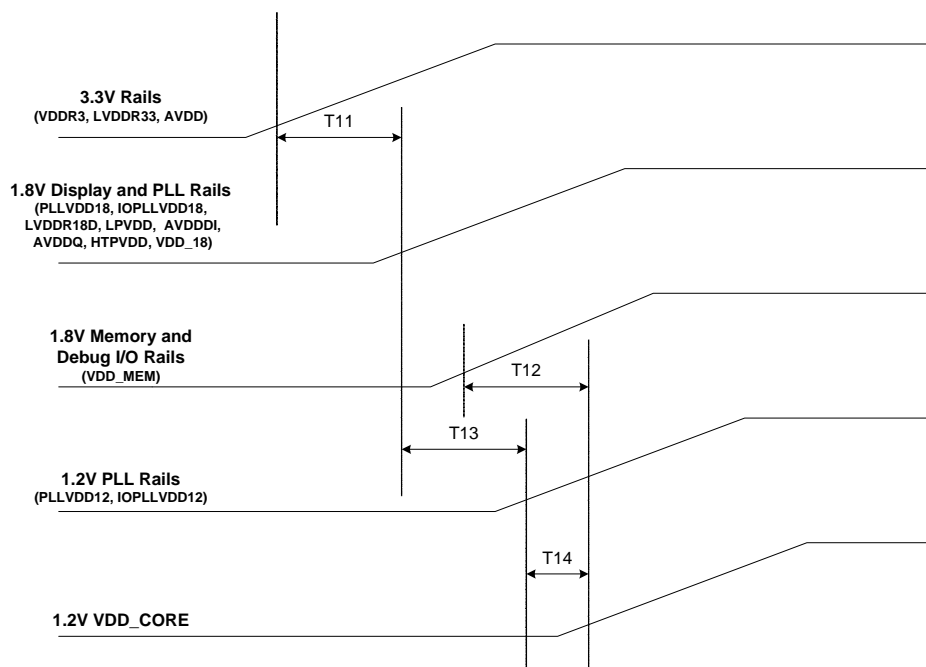


Figure 4-1 Power Rail Power Up Sequence for the M690T

Table 4-5 M690T Power Rail Power Up Sequence Requirements

Symbol	Parameter	Voltage Difference During Ramping	
		Minimum (V)	Maximum (V)
T11	3.3V rails ramp high relative to 1.8V display and PLL rails	0	2.1
T12	1.8V memory and debug I/O rail ramps high relative to VDD_CORE (1.2V)	0	No restrictions
T13	1.8V display and PLL rails ramp high relative to 1.2V PLL rails	0	No restrictions
T14	1.2V PLL rails ramp high relative to VDD_CORE (1.2V)	0	No restrictions

**Notes:**

1. Power rails in the same group may require separate power sources. Please refer to the *RS690/RS485-series IGP Motherboard Design Guide* for details.
2. There are no specific requirements for the following 1.2V rails: VDD\_HT, VDDA\_12, and VDD\_PLL.
3. For power down, the rails should either be turned off simultaneously or in the reversed order of the above power up sequence. Variations in speeds of decay due to different capacitor discharge rates can be safely ignored.

Figure 4-1 above only shows the power up sequence for the power rails that the M690T connects to. For a power up sequence for the whole M690T platform, please refer to the *RS690/RS485-Series IGP Motherboard Design Guide*.

## 4.8 LCD Panel Power Up/Down Timing

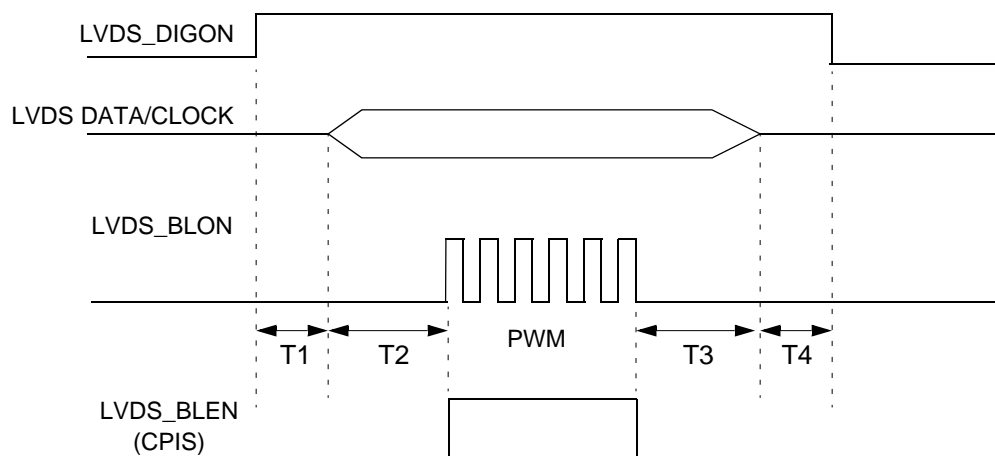


Figure 4-2. LCD Panel Power Up/Down Timing

Table 4-6 LCD Power Up/Down Timing

Parameter	Description	Time ( $\mu$ s)*
T1	Delay from LVDS_DIGON active to LVDS data/clock	$M \cdot N1$
T2	Delay from LVDS data/clock to LVDS_BLON active	$M \cdot N2$
T3	Delay from LVDS_BLON inactive to LVDS inactive	$M \cdot N3$
T4	Delay from LVDS inactive to LVDS_DIGON inactive	$M \cdot N4$

\*Note: Values for M, N1, N2, N3 and N4 are programmable through the following registers:

M = LVTMA\_PWRSEQ\_REF\_DIV.LVTMA\_PWRSEQ\_REF\_DIV (1- 255)

N1 = LVTMA\_PWRSEQ\_DELAY1.LVTMA\_PWRUP\_DELAY1 (0 - 15)

N2 = LVTMA\_PWRSEQ\_DELAY1.LVTMA\_PWRUP\_DELAY2 (0 - 15)

N3 = LVTMA\_PWRSEQ\_DELAY1.LVTMA\_PWRDN\_DELAY1 (0 - 15)

N4 = LVTMA\_PWRSEQ\_DELAY1.LVTMA\_PWRDN\_DELAY2 (0 - 15)

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# Chapter 5

## Electrical Characteristics and Physical Data

### 5.1 Electrical Characteristics

#### 5.1.1 Maximum and Minimum Ratings

**Table 5-1 Maximum and Minimum Ratings**

Pin	Minimum	Typical	Maximum	Unit	Comments
VDD_CORE	0.95	1.0-1.2	1.26	V	ASIC core power
VDD_18	1.71	1.8	1.89	V	Core transform power for GPIOs and power for DFT_GPIOs
VDD_MEM	1.71	1.8	1.89	V	I/O power for the DDR memory and debug I/Os
VDD_HT	1.14	1.2	1.26	V	I/O power for HyperTransport™ interface
VDDR3	3.135	3.3	3.465	V	3.3 Volt I/O power
VDDA_12	1.14	1.2	1.26	V	PCI Express Interface main I/O power
AVDDDI	1.71	1.8	1.89	V	Digital power for DAC
AVDDQ	1.71	1.8	1.89	V	Band gap reference voltage for DAC
AVDD	3.135	3.3	3.465	V	I/O power for DAC
LPVDD	1.71	1.8	1.89	V	Power for LVDS PLL macro
LVDDR18D	1.71	1.8	1.89	V	1.8V power
LVDDR33	3.135	3.3	3.465	V	3.3V power
PLVDD12	1.14	1.2	1.26	V	1.2V power for system PLLs
PLVDD18	1.71	1.8	1.89	V	1.8V power for system PLLs
IOPLVDD12	1.14	1.2	1.26	V	1.2V power for memory I/O PLLs
IOPLVDD18	1.71	1.8	1.89	V	1.8V power for memory I/O PLLs
HTPVDD	1.71	1.8	1.89	V	Power for HyperTransport interface PLL

**Note:** Numbers in this table are to be qualified.

### 5.1.2 DC Characteristics

**Table 5-2 DC Characteristics for 3.3V TTL Signals**

Pins	Symbol	Description	Minimum	Maximum	Unit
ALLOW_LDTSTOP† BMREQ#† DACVSYNC DACSCL*†, DACSDA DACHSYNC† DDC_DATA LVDS_DIGON LVDS_BLON LVDS_BLEN LDTSTOP#† OSCIN‡ I2C_DATA, I2C_CLK* POWERGOOD‡ STRP_DATA SYSRESET#† TESTMODE‡ TMDS_HPD‡ SUS_STAT#‡	VILdc	DC voltage at PAD pin that will produce a stable low at the Y pin of macro	–	0.6	V
	VIHdc	DC voltage at PAD pin that will produce a stable high at the Y pin of macro	1.4	–	V
	VOL	Output low voltage	–	0.35	V
	VOH	Output high voltage	2.6	–	V
	IOL	Output low current at V=0.1V	2.3*	–	mA
	IOH	Output high current at V=VDDR-0.1V	2.2*	–	mA

**Notes:**

‡ Input pins. Output parameters in the table do not apply.

† Output pins. Input parameters in the table do not apply.

\* DACSCL and I2C\_CLK have different values for IOL and IOH:

DACSCL: IOL=14mA, IOH=5.8mA

I2C\_CLK: IOL=9.5mA, IOH=3.2mA

Other numbers in this tables are applicable to the two signals.

**Table 5-3 DC Characteristics for 1.8V TTL Signals**

Pins	Symbol	Description	Minimum	Maximum	Unit
DFT_GPIO[5:0]†	VILdc	DC voltage at PAD pin that will produce a stable low at the Y pin of macro	–	0.69*	V
	VIHdc	DC voltage at PAD pin that will produce a stable high at the Y pin of macro	0.81*	–	V
	VOL	Output low voltage	–	0.59	V
	VOH	Output high voltage	1.16	–	V
	IOL	Output low current at V=0.1V	1.52	–	mA
	IOH	Output high current at V=VDDR-0.1V	1.79	–	mA

\* **Note:** Measured with edge rate of 1µs at PAD pin.

**Table 5-4 DC Characteristics for the HTREFCLK Pad (66.66MHz)**

Symbol	Description	Minimum	Typical	Maximum	Comments
VIL	Input Low Voltage	–	0V	0.2V	–
VIH	Input High Voltage	1.4V	1.8V	–	–
VIMAX	Maximum Input Voltage	–	–	2.1V	–

**Table 5-5 DC Characteristics for the OSCIN Pad (14.3181818MHz)**

Symbol	Description	Minimum	Typical	Maximum	Comments
VIL	Input Low Voltage	–	0V	0.6V	–
VIH	Input High Voltage	2.5V	2.6V	–	–
VIMAX	Maximum Input Voltage	–	–	3.3V	–

**Table 5-6 DC Characteristics for the DDR2 Interface**

Symbol	Description	Minimum	Maximum	Comments
VIL(dc)	DC Input Low Voltage	-0.3V	VREF-0.15V	For DQ and DQS
VIH(dc)	DC Input High Voltage	VREF + 0.15V	VDDQ + 0.3V	For DQ and DQS. (VDDQ is I/O voltage of memory device.)
VIL(ac)	AC Input Low Voltage	–	VREF - 0.31	For DQ and DQS
VIH(ac)	AC Input High Voltage	VREF + 0.31V	–	For DQ and DQS
VUSH	Minimum Voltage Allowed for Undershoot	- 0.3V	–	For DQ and DQS
VOSH	Maximum Voltage Allowed for Overshoot	–	VDDQ + 0.3V	For DQ and DQS. (VDDQ is I/O voltage of memory device.)
VOI	Output Low Voltage	0.186V	0.305V	I <sub>out</sub> = 16.5mA
VOH	Output High Voltage	1.90V	2.50V	I <sub>out</sub> = -16.5mA
VREF	DC Input Reference Voltage	1.125V	1.375V	
ILI	Input Leakage Current	10μA	15μA	
ILO	Tri-state Leakage Current	10μA	15μA	
CIN	Input Capacitance	3pF	5pF	

**Table 5-7 DC Characteristics for the TMDS Interface Multiplexed on the PCI Express® Gfx Lanes**

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Note
VH	Single-ended High Level Output Voltage	AVCC - 10	–	AVCC + 10	mV	1
VL	Single-ended Low Level Output Voltage	AVCC - 600	–	AVCC - 400	mV	1
VSW	Single-ended Output Swing	400	–	600	mV	
VOS	Differential Output Overshoot (Ringing)	–	–	15%*2VSW	–	
VUS	Differential Output Undershoot (Ringing)	–	–	25%*2VSW	–	

**Notes:**

- 1 AVCC stands for the termination supply voltage of the receiver, which is 3.3V +/- 5%.
- 2 Figure 5-1 below illustrates some of the DC characteristics of the TMDS interface.

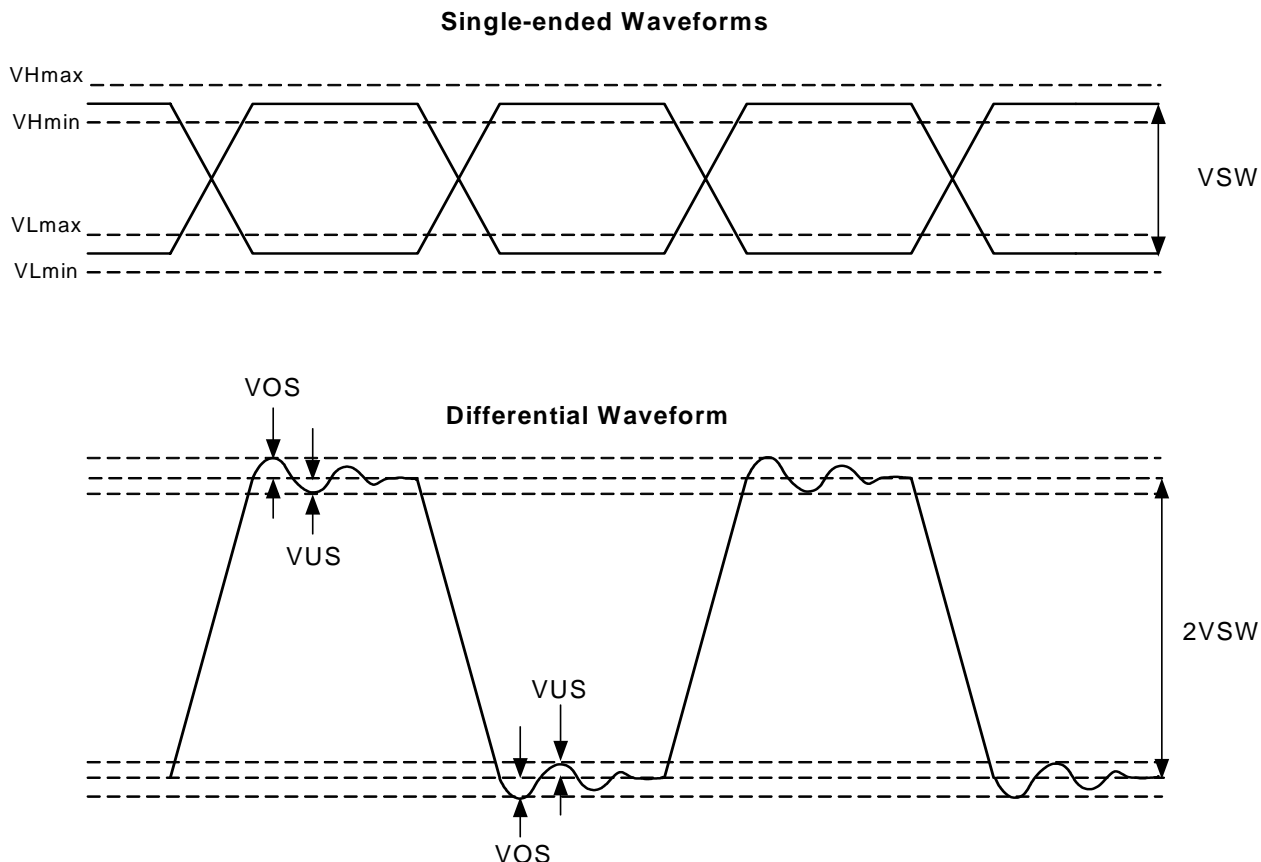


Figure 5-1 DC Characteristics of the TMDS Interface

Table 5-8 Electrical Requirements for the LVDS Interface

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Note
VCM	Differential Output Common-mode Voltage	1.125	–	1.375	V	1
DVCM	Differential Output Common-mode Voltage Ripple	–	–	150	mV	1
VH	Single-ended High Level Output Voltage	$V_{CM} + 0.257$	–	$V_{CM} + 0.454$	V	1
VL	Single-ended Low Level Output Voltage	$V_{CM} - 0.257$	–	$V_{CM} - 0.454$	V	1
VSW	Single-ended Output Swing	257	–	454	mV	1
VOS	Differential Output Overshoot (Ringing)	–	–	160	mV	1
VUS	Differential Output Undershoot (Ringing)	–	–	160	mV	1
IDDLP	Average Supply Current at	–	10.0	–	mA	2
IDDLV	Average Supply Current at	–	100.0	–	mA	2
IPDLP	Power Down Current at	–	10.0	–	$\mu$ A	3
IPDLV	Power Down Current at	–	10.0	–	$\mu$ A	3

**Notes:**

- 1 Differential termination is 100 ohms.
- 2 Measured under typical conditions, at minimum Differential Clock Frequency and maximum LVDS PLL VOC frequency.
- 3 Measured under typical conditions, based on typical leakage values.
- 4 Figure 5-2 below illustrates the DC characteristics of the LVDS interface.

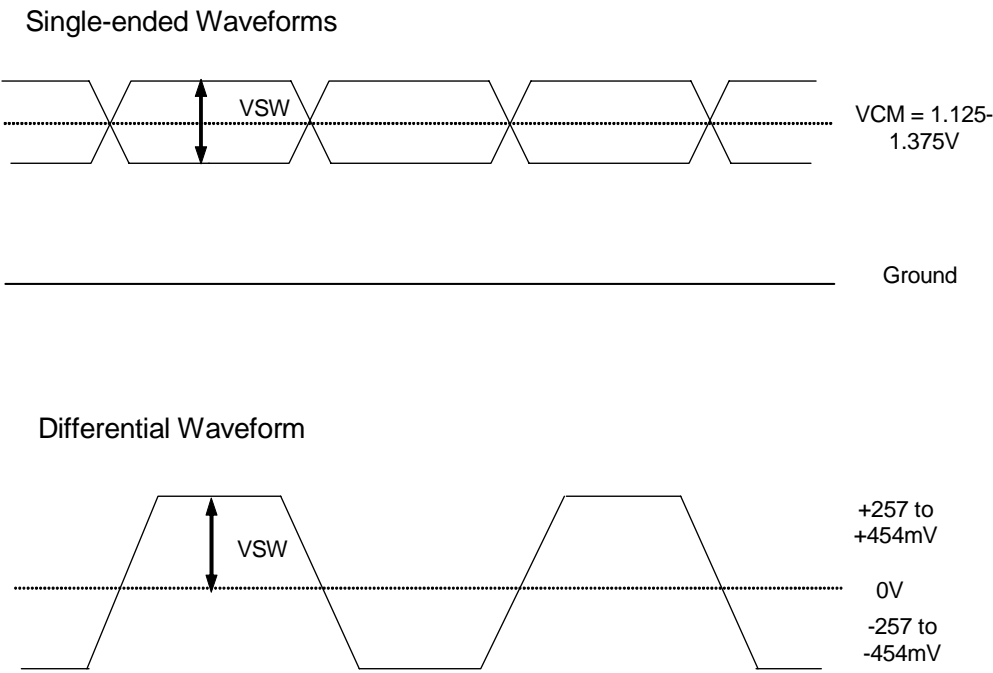


Figure 5-2 DC Characteristics of the LVDS Interface

5.2 M690T Thermal Characteristics

This section describes some key thermal parameters of the M690T. For a detailed discussion on these parameters and other thermal design descriptions including package level thermal data and analysis, please consult the *Thermal Design and Analysis Guidelines for the RS690 Product Family*.

5.2.1 M690T Thermal Limits

Table 5-9 M690T Thermal Limits

Parameter	Minimum	Nominal	Maximum	Unit	Note
Operating Case Temperature	0	—	95	°C	1
Absolute Rated Junction Temperature	—	—	125	°C	2
Storage Temperature	-40	—	60	°C	

Table 5-9 M690T Thermal Limits (Continued)

Parameter	Minimum	Nominal	Maximum	Unit	Note
Ambient Temperature	0	—	45	°C	3
Thermal Design Power	—	8	—	W	4

**Notes:**

1 - The maximum operating case temperature is the die geometric top-center temperature measured via a thermocouple based on the methodology given in the document *Thermal Design and Analysis Guidelines for the RS690 Product Family* (Chapter 10). This is the temperature at which the functionality of the chip is qualified.

2 - The maximum absolute rated junction temperature is the junction temperature at which the device can operate without causing damage to the ASIC. This temperature can be measured via the integrated thermal diode described in the next section.

3 - The ambient temperature is defined as the temperature of the local intake air to the thermal management device. The maximum ambient temperature is dependent on the heat sink's local ambient conditions as well as the chassis' external ambient, and the value given here is based on AMD's reference heat sink solution for the M690T. Refer to Chapter 7 in the *Thermal Design and Analysis Guidelines for the RS690 Product Family* for heatsink and thermal design guidelines. Refer to Chapter of the above mentioned document for details of ambient conditions.

4 - The Thermal Design Power (TDP) is defined as the worst-case power dissipation while running currently available applications at nominal voltages and at the maximum operating temperature. Since the core power of modern ASICs using 90nm and smaller process technology can vary significantly, parts specifically screened for higher core power were used for TDP measurement. The TDP is intended only as a design reference. It is not an absolute maximum power under all conditions. The value shown here is a preliminary estimate only.

## 5.2.2 Thermal Diode Characteristics

The M690T has an on-die thermal diode, with its positive and negative terminals connected to the THERMALDIODE\_P and THERMALDIODE\_N pins respectively. Combined with a thermal sensor circuit, the diode temperature, and hence the ASIC temperature, can be derived from a differential voltage reading ( $\Delta V$ ). The equation relating  $T$  to  $\Delta V$  is given below:

$$\Delta V = \frac{\eta \times K \times T \times \ln(N)}{q}$$

where:

$\Delta V$  = Difference of two base-to-emitter voltage readings, one using current =  $I$  and the other using current =  $N \times I$

$N$  = Ratio of the two thermal diode currents (=10 when using an ADI thermal sensor, e.g. ADM 1020, 1030)

$\eta$  = Ideality factor of the diode

$K$  = Boltzman's Constant

$T$  = Temperature in Kelvin

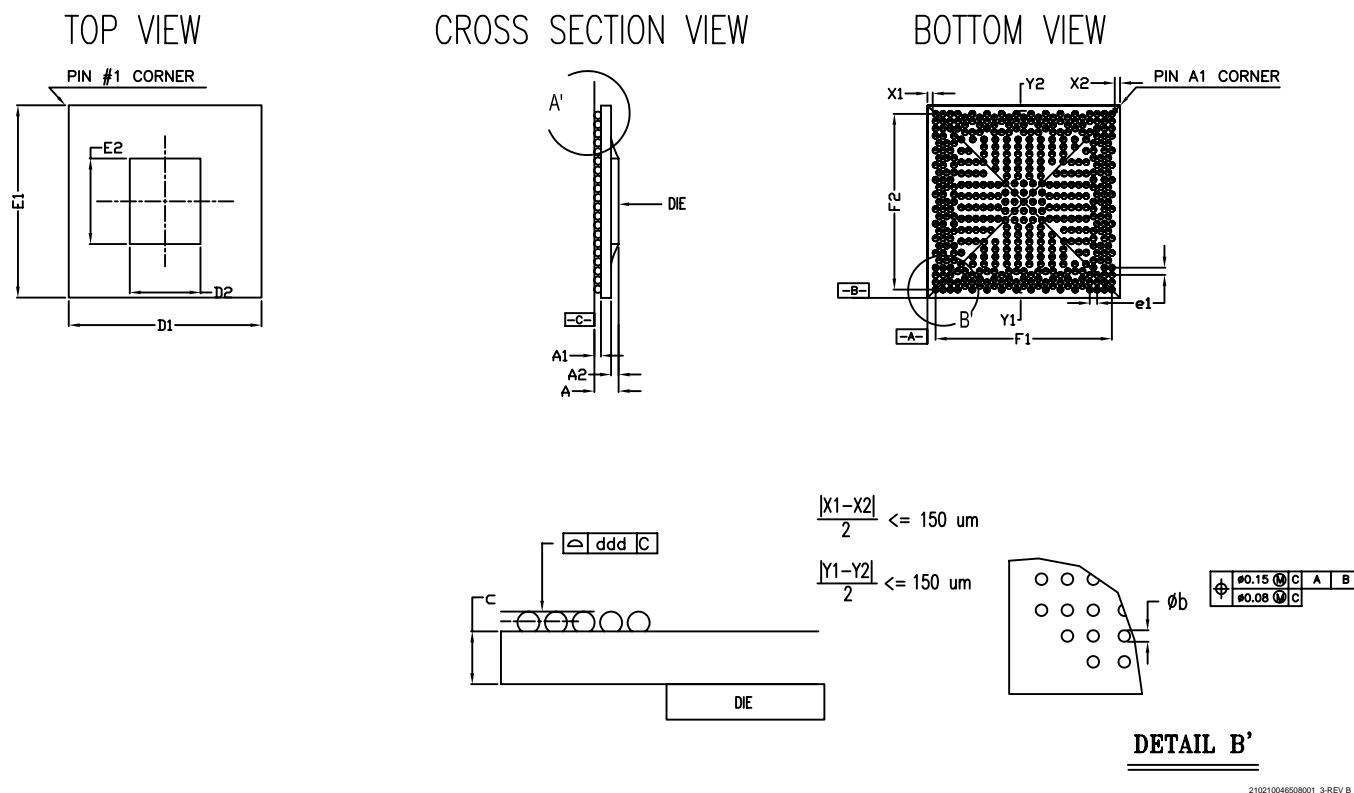
$q$  = Electron charge

The series resistance of the thermal diode ( $R_T$ ) must be taken into account as it introduces an error in the reading (for every  $1.0\Omega$ , approximately  $0.8^\circ\text{C}$  is added to the reading). The sensor circuit should be calibrated to offset the  $R_T$  induced, plus any other known fixed error. Measured values of diode ideality factor and series resistance for the diode circuit are defined in the *Thermal Design and Analysis Guidelines for the RS690 Product Family*.

### 5.3 Package Information

### 5.3.1 Physical Dimensions

*Figure 5-3* and *Table 5-10* describe the physical dimensions of the M690T package. *Figure 5-4* shows the detailed ball arrangement for the M690T.

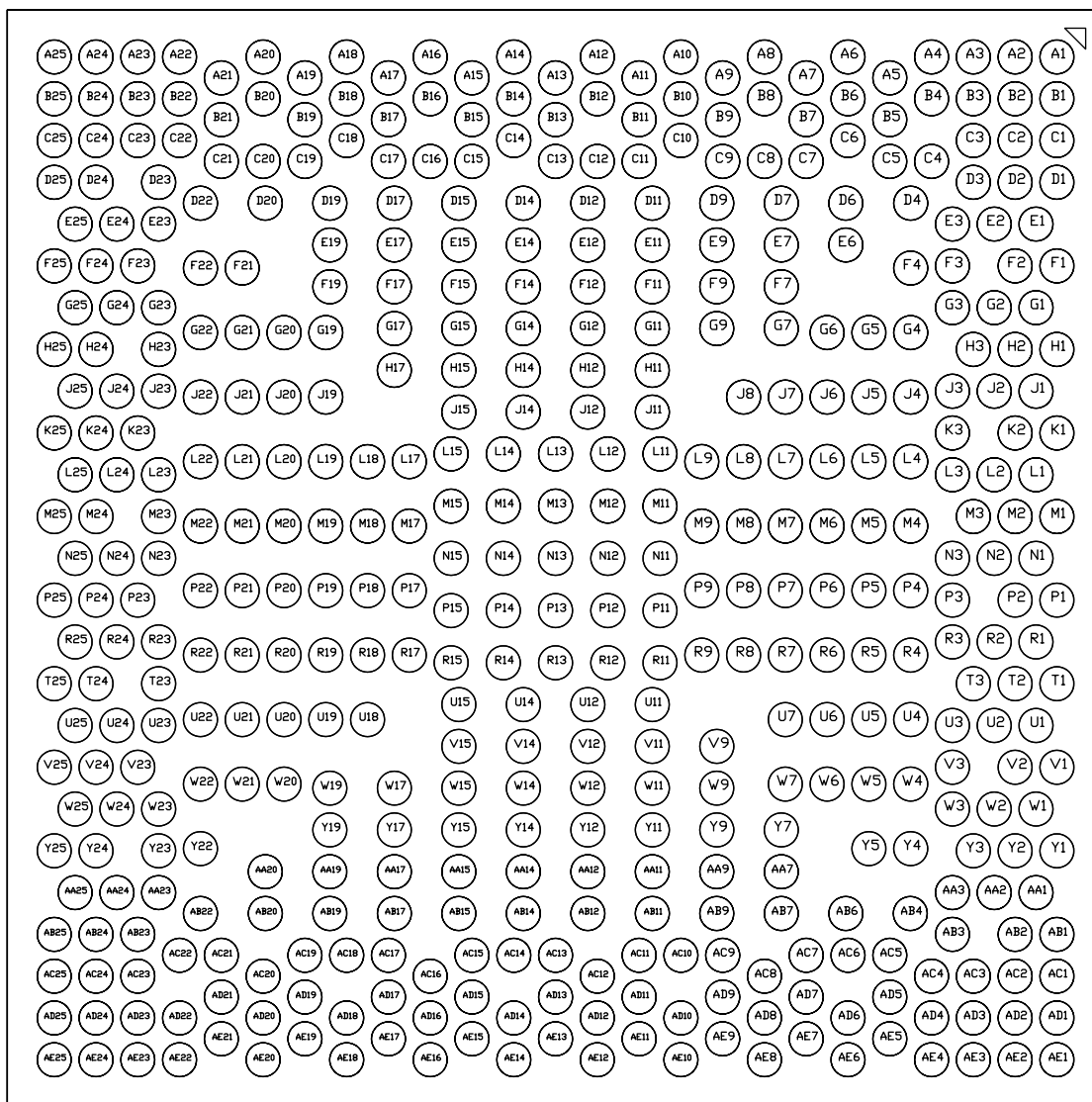


### Figure 5-3 M690T Package Outline

### Table 5-10 M690T 465-Pin FCBGA Package Physical Dimensions

Ref.	Minimum(mm)	Typical(mm)	Maximum(mm)
c	0.96	1.06	1.16
A	2.18	2.33	2.48
A1	0.30	0.40	0.50
A2	0.84	0.87	0.90
φb	0.40	0.50	0.60
D1	20.80	21.00	21.20
D2	-	7.33	-
E1	20.80	21.00	21.20
E2	-	6.93	-
F1	-	19.20	-
F2	-	19.20	-
e1	-	0.80*	-
ddd	-	-	0.15

\* **Note:** Only minimum pitch shown.



**Figure 5-4 M690T Ball Arrangement**

### 5.3.2 Pressure Specification

To avoid damages to the ASIC (die or solder ball joint cracks) caused by improper mechanical assembly of the cooling device, follow the recommendations below:

- It is recommended that the maximum pressure which is evenly applied across the contact area between the thermal management device and the die does not exceed 40 PSI. Note that a contact pressure of 30-40 PSI is adequate to secure the thermal management device and achieve the lowest thermal contact resistance with a temperature drop across the thermal interface material of no more than 3°C. Also, the surface flatness of the metal spreader should be 0.001 inch/1 inch.
- Pre-test the assembly fixture with a strain gauge to make sure that the flexing of the final assembled board and the pressure applying around the ASIC package will not exceed 600 micron strain under any circumstances.
- Ensure that any distortion (bow or twist) of the board after SMT and cooling device assembly is within industry guidelines (IPC/EIA J-STD-001). For measurement method, refer to the industry approved technique described in the manual IPC-TM-650, section 2.4.22.



### 5.3.3 Board Solder Reflow Process Recommendations

#### 5.3.3.1 Stencil Opening Size for Solderball Pads on PCB

It is recommended that the stencil aperture for solderballs be kept at the same size as the land pads' except for the nine pads at each corner of the ASIC package, for which a maximum size of 400 $\mu$ m is recommended (see [Figure 5-5](#) below). This recommendation is based on AMD's sample land pattern design for the M690T, which is available from your AMD CSS representative.

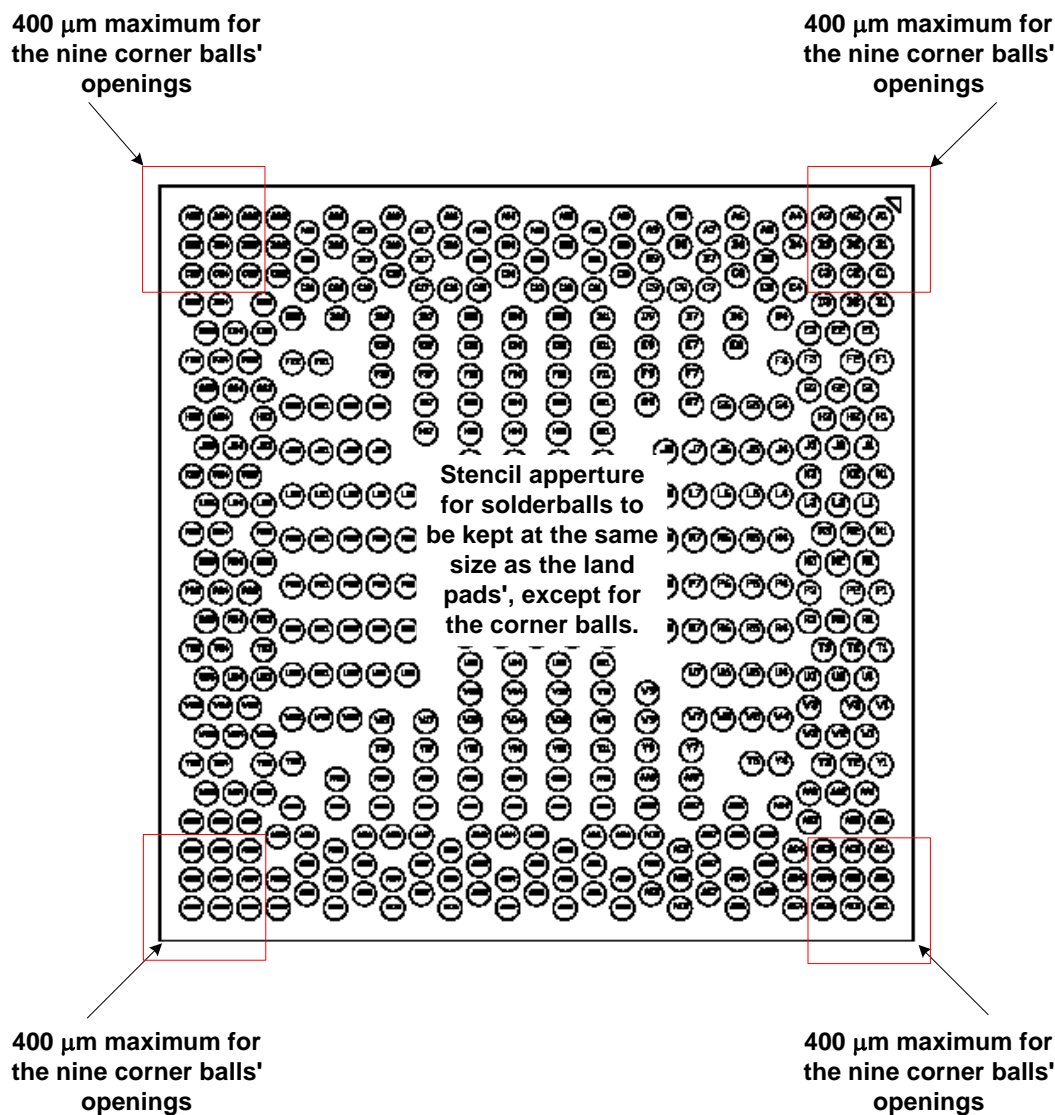


Figure 5-5 Stencil Opening Recommendations

#### 5.3.3.2 Reflow Profile

A reference reflow profile is given below. Please note the following when using RoHS/lead-free solder (SAC105/305/405 Tin-Silver-Cu):

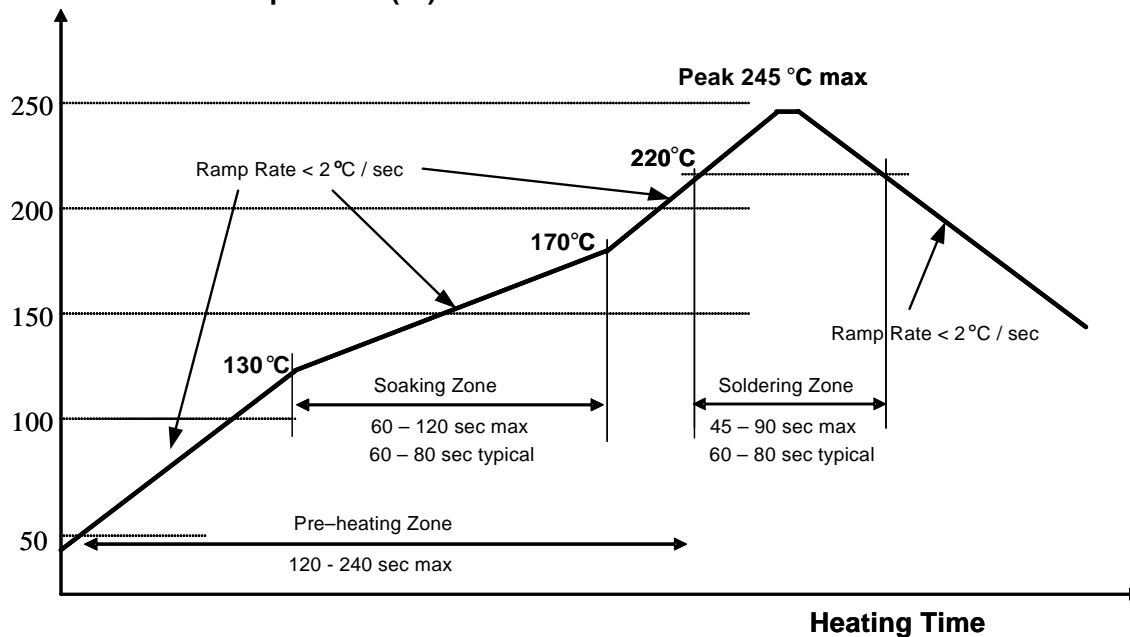
- The final reflow temperature profile will depend on the type of solder paste and chemistry of flux used in the SMT process. Modifications to the reference reflow profile may be required in order to accommodate the requirements of the other components in the application.

- An oven with 10 heating zones or above is recommended.
- To ensure that the reflow profile meets the target specification on both sides of the board, a different profile and oven recipe for the first and second reflow may be required.
- Mechanical stiffening can be used to minimize board warpage during reflow.
- It is suggested to decrease temperature cooling rate to minimize board warpage.
- This reflow profile applies only to RoHS/lead-free (high temperature) soldering process and it should not be used for Eutectic solder packages. Damage may result if this condition is violated.
- Maximum 3 reflows are allowed on the same part.

**Table 5-11 Recommended Board Solder Reflow Profile - RoHS/Lead-Free Solder**

Profiling Stage	Temperature	Process Range
Overall Preheat	Room temp to 220°C	2 mins to 4 mins
Soaking Time	130°C to 170°C	Typical 60 – 80 seconds
Liquidus	220°C	Typical 60 – 80 seconds
Ramp Rate	Ramp up and Cooling	<2°C / second
Peak	Max. 245°C	235°C +/-5°C
Temperature at peak within 5°C	240°C to 245°C	10 – 30 seconds

**Solder/Part Surface Temperature (°C)**



**Figure 5-6 RoHS/Lead-Free Solder (SAC305/405 Tin-Silver-Copper) Reflow Profile**

# Chapter 6

## Power Management and ACPI

### 6.1 ACPI Power Management Implementation

This chapter describes the support for ACPI power management provided by the M690T. The M690T supports ACPI Revision 1.0b. The hardware, system BIOS, video BIOS, and drivers of the M690T have all the logic required for meeting the power management specifications of PC2001, OnNow, and the Windows Logo Program and Device Requirements version 2.1. [Table 6-1, “ACPI States Supported by the M690T,”](#) describes the ACPI states supported by the M690T. [Table 6-2, “ACPI Signal Definitions,”](#) describes the signals used in the ACPI power management scheme of the M690T.

**Table 6-1 ACPI States Supported by the M690T**

ACPI State	Description
Graphics States:	
D0	Full on, display active.
D1	Display Off. M690T power on. Configuration registers, state, and main memory contents retained.
D3 Hot	Similar to D1, with additional power saving and the graphics PLLs shut off.
D3 Cold	M690T power off.
Processor States:	
S0/C0: Working State	Working State. The processor is executing instructions.
S0/C1: Halt	CPU Halt state. No instructions are executed. This state has the lowest latency on resume and contributes minimum power savings.
S0/C2: Stop Grant Caches Snoopable	Stop Grant or Cache Snoopable CPU state. This state offers more power savings but has a higher latency on resume than the C1 state.
S0/C3: Stop Grant Caches Not Snoopable	Stop Grant or Cache not Snoopable Sleep state. The CPU's caches maintain state but ignore any snoops. This state offers more power savings but has a higher latency on resume than the C1 and C2 states.
System States:	
S1: Standby Powered On Suspend	System is in Standby mode. This state has low wakeup latency on resume. OEM support of this state is optional.
S3: Standby Suspend to RAM	System is off but context is saved to RAM. OEM support of this state is optional. System memory is put into self-refresh.
S4: Hibernate Suspend to Disk	System is off but context is saved to disk. When the system transitions to the working state, the OS is resumed without a system re-boot.
S5: Soft Off	System is off. OS re-boots when the system transitions to the working state.
G3: Mechanical Off	Occurs when system power (AC or battery) is not present or is unable to keep the system in one of the other states.

**Note:** Also supported are additional processor power states that are not part of the ACPI specification, e.g. C1E (C1 Enhanced) and C3 pop-up. Please refer to the *SB600 Databook* and the *RS690 Register Programming Requirements* for more information.

**Table 6-2 ACPI Signal Definitions**

Signal Name	Description	Source
ALLOW_LDTSTOP	Output to the Southbridge to allow LDTSTOP# assertion.	Northbridge
LDTSTOP#	HyperTransport™ Technology Stop: Enables and disables links during system state transitions.	Southbridge
POWERON#	Power on	Power switch
RESET#	Global Reset	Southbridge

## 6.2 Power Management for the Graphics Controller

The M690T supports power management for the embedded graphics device as specified by the PCI Bus Power Management Interface Specification version 1.0, according to which the integrated graphics core of the M690T qualifies as a device embedding a single function in the power management system.

### 6.2.1 PCI Function Power States

There are up to four power states defined for each PCI function associated with each PCI device in the system. These power states are D0, D1, D2 and D3. D0 (on) consumes the most power while D3 (off) consumes the least. D1 and D2 enable levels of power savings in between those of D0 and D3. The concepts of these power states are universal for all functions in the system. When transitioned to a given power management state, the intended functional behavior is dependent upon the type (or class) of the function.

### 6.2.2 PCI Power Management Interface

The four basic power management operations are:

- Capabilities Reporting
- Power Status Reporting
- Setting Power State
- System Wakeup

All four of these capabilities are required for each power management function with the exception of wakeup event generation.

This section describes the format of the registers in the PCI Configuration Space that are used by these power management operations. The Status and Capabilities Pointer (CAP\_PTR) fields have been highlighted to indicate where the PCI Power Management features appear in the standard Configuration Space Header.

**Table 6-3 Standard PCI Configuration Space Header Type 0**

RegisterFields(32bits)				Offset
MSB		LSB		
Device ID		Vendor ID		00h (LSB)
Status (with Bit 4 set to 1)		Command		04h
Class Code		Revision ID		08h
BIST	Header Type	Latency Timer	Cache Line Size	0Ch
Base Address Registers				10h
				14h
				18h
				1Ch
				20h
				24h
CardBus CIS Pointer				28h
Subsystem ID		Subsystem Vendor ID		2Ch
Expansion ROM Base Address				30h
Reserved			CAP_PTR	34h
Reserved				38h
Max_Lat	Min_Gnt	Interrupt Pin	Interrupt Line	3Ch

### 6.2.3 Capabilities List Data Structure in PCI Configuration Space

The Capabilities bit in the PCI Status register (offset = 06h) indicates whether or not the subject function implements a linked list of extended capabilities. Specifically, if bit 4 is set, the CAP\_PTR register is implemented to give offset to the first item in the Capabilities link list.

**Table 6-4 PCI Status Register**

Bits	Default Value	Read/Write	Description
15:05	--	--	Refer to <i>PCI Local Bus Specification, Revision 2.2</i>
04	1b	Read Only	This bit indicates whether this function implements a list of extended capabilities such as PCI power management. When set, this bit indicates the presence of Capabilities. A value of 0 implies that this function does not implement Capabilities.
03:00	0h	Read Only	Reserved

The location of the Capabilities Pointer (CAP\_PTR) depends on the PCI header type. See *PCI specification Revision 2.2* for specification of CAP\_PTR offsets.

**Table 6-5 Capabilities Pointer (CAP\_PTR)**

Bits	Default Value	Read/Write	Description
07:00	50h	Read Only	The CAP_PTR provides an offset in the PCI Configuration Space of the function to access the location of the first item in the Capabilities linked list. The CAP_PTR offset is DWORD aligned, so that the two least significant bits are always zeros.

The graphics core implements extended capabilities of the AGP and Power Management. It needs to provide the standardized register interface. The first entry in the chain of descriptors has to be the PMI descriptor, as this functionality will be supported even if the M690T operates as a PCI device. The Capabilities Identifier for Power Management is 01h.

#### 6.2.4 Register Block Definition

This section describes the PCI Power Management Interface registers. These registers are implemented inside the Host Interface (HI) as part of the configuration space of the device (M690T).

**Table 6-6 Power Management Register Block**

Register Fields	Offset
Capabilities ID	00h
Next Item Pointer	01h
Power Management Capabilities (PMC)	02h
Power Management Control/Status Register (PMCSR)	04h
Reserved	06h

The first 16 bits (Capabilities ID [offset = 0] and Next Item Pointer [offset = 1]) are used for the linked list infrastructure. The next 32 bits (PMC [offset = 2] and PMCSR registers [offset = 4]) are required for compliance with this specification.

As with all PCI configuration registers, these registers may be accessed as bytes, 16-bit words, or 32-bit DWORDs. All of the write operations to the reserved registers must be treated as no-ops. This implies that the access must be completed normally on the bus and the data should be discarded. Read accesses to the reserved or the unimplemented registers must be completed normally and a data value of 0000h should be returned.

**Table 6-7 Power Management Control/Status Register (PMCSR)**

Field Name	Bits	Default (Reset)	Description
Power State	1:0	00b	This field describes the power state of the graphics core.
			States      Function
			00 = D0      Normal operation, no power savings enabled
			01 = D1      Sleeping state 1: Display is off Host access to DRAM is allowed
			10 = D2      Sleeping state 2 Display is off. All engines are off. Graphics core does not respond to host accesses to the frame buffer.
			11 = D3      Everything, except Host Interface, is turned off.
Power State	15:2	00h	These Read Only bits will return the clock status of each clock tree, generated inside the clock block.

The offset for each register is listed as an offset from the beginning of the linked list item that is determined either from the CAP\_PTR (if Power Management is the first item in the list) or the NEXT\_ITEM\_PTR of the previous item in the list.

### 6.2.5 Capability Identifier: Cap\_ID (Offset = 0)

The Capability Identifier, when read by system software as 01h, indicates that the data structure currently being pointed to is the PCI Power Management data structure. Each function of a PCI device may have only one item in its capability list with Cap\_ID set to 01h.

**Table 6-8 Capability Identifier (Cap\_ID)**

Bits	Default Value	Read/Write	Description
7:0	01h	Read Only	This field, when set to 01h, identifies the linked list item as being the PCI Power Management registers

*Figure 6-1, 'Linked List for Capabilities,'* shows the implementation of the capabilities list. The CAP\_PTR gives the location of the first item in the list. PCI Power Management registers have been stated as example in this list (although the capabilities can be in any order).

- The first byte of each entry is required to be the ID of that capability. The PCI Power Management capability has an ID of 01h.
- The next byte is a pointer giving an absolute offset in the functions PCI Configuration Space to the next item in the list and must be DWORD aligned.
- If there are no more entries in the list, the NEXT\_ITEM\_PTR must be set to 0 to indicate an end of the linked list. Each capability can then have registers following the NEXT\_ITEM\_PTR.

The definition of these registers (including layout, size, and bit definitions) is specific to each capability. The PCI Power Management Register Block is defined in *Figure 6-1, 'Linked List for Capabilities,'* below.

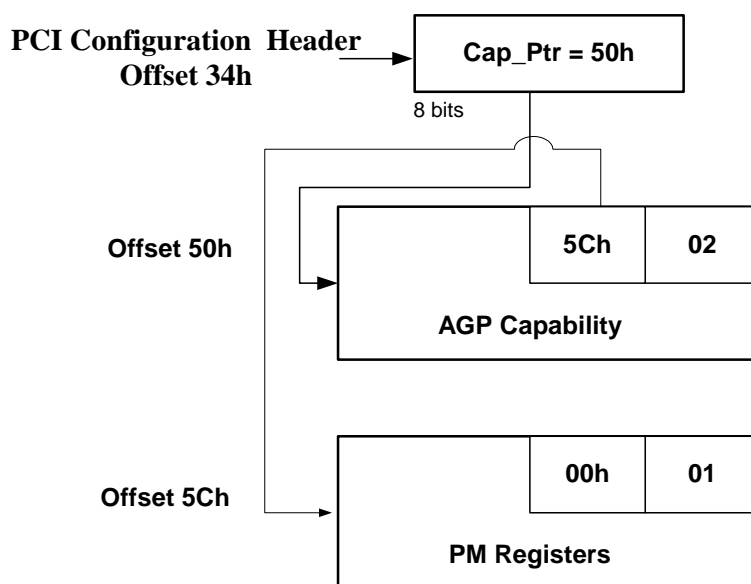


Figure 6-1 Linked List for Capabilities

## 6.2.6 Next Item Pointer

The Next Item Pointer register describes the location of the next item in the capability list of the function. The value given is an offset in the PCI Configuration Space of that function. This register must be set to 00h if the function does not implement any other capabilities defined by the PCI Specifications for inclusion in the capabilities list, or if power management is the last item in the list.

Table 6-9 Next Item Pointer (NEXT\_ITEM\_PTR)

Bits	Default Value	Read/Write	Description
7:0	80h	Read Only	This field provides an offset in the PCI Configuration Space of the function pointing to the location of next item in the capability list of the function. For Power Management of the M690T, this pointer is set to 80h and it points to the next capability pointer of the MSI structure.

## 6.2.7 PMC - Power Management Capabilities (Offset = 2)

The Power Management Capabilities register is a 16-bit Read Only register that provides information on the capabilities of the function related to power management. The information in this register is generally static and is known at design time.

Table 6-10 Power Management Capabilities – PMC

Bits	Default Value	Read/Write	Description
15:11	00111b	Read Only	This 5-bit field indicates the power states in which the function may assert PME#. A value of 0b for any bit indicates that the function is not capable of asserting the PME# signal while in that power state. bit(11) XXXX1b - PME# can be asserted from D0. bit(12) XXX1Xb - PME# can be asserted from D1. bit(13) XX1XXb - PME# can be asserted from D2. bit(14) X0XXXb - PME# cannot be asserted from D3hot. bit(15) 0XXXXb - PME# cannot be asserted from D3cold.
10	1b	Read Only	M690T supports D2.

**Table 6-10 Power Management Capabilities – PMC (Continued)**

Bits	Default Value	Read/ Write	Description
9	1b	Read Only	M690T supports D1.
8:6	000b	Read Only	Reserved
5	1b	Read Only	The Device Specific Initialization bit indicates whether special initialization of this function is required (beyond the standard PCI configuration header) before the generic class device driver is able to use it. The M690T requires device specific initialization after Reset; this field must therefore return a value 1 to the system.
4	0b	Read Only	Reserved
3	0b	Read Only	Reserved
2:0	001b	Read Only	A value of 001b indicates that this function complies with Revision 1.0 of the PCI Power Management Interface Specification.



# Chapter 7

## Testability

### 7.1 Test Capability Features

The M690T has integrated test modes and capabilities. These test features cover both the ASIC and board level testing. The ASIC tests provide a very high fault coverage and low DPM (Defect Per Million) ratio of the part. The board level tests modes can be used for motherboard manufacturing and debug purposes. The following are the test modes of the M690T:

- Full scan implementation on the digital core logic that provides about 99% fault coverage through ATPG (Automatic Test Pattern Generation Vectors).
- Dedicated test logic for the on-chip custom memory macros to provide complete coverage on these modules.
- Improved access to the analog modules and PLLs in the M690T to allow full evaluation and characterization of these modules.
- A JTAG test mode (which is not entirely compliant to the IEEE 1149.1 standard) to allow board level testing of neighboring devices.
- An XOR TREE test mode on all the digital I/Os to allow for proper soldering verification at the board level.
- A VOH/VOL test mode on all digital I/Os to allow for proper verification of output high and output low voltages at the board level.

These test modes can be accessed through the settings on the instruction register of the JTAG circuitry.

### 7.2 Test Interface

**Table 7-1 Pins on the Test Interface**

Pin Name	Ball number	Type	Description
TESTMODE	C3	I	IEEE 1149.1 test port reset
DDC_DATA	B3	I	TMS: Test Mode Select (IEEE 1149.1 test mode select)
I2C_DATA	B4	I	TDI: Test Mode Data In (IEEE 1149.1 data in)
I2C_CLK	A2	I	TCLK: Test Mode Clock (IEEE 1149.1 clock)
TMDS_HPD	C14	O	TDO: Test Mode Data Out (IEEE 1149.1 data out)
POWERGOOD	C11	I	I/O Reset
OSCIN	B11	I	I/O Test Clock

### 7.3 XOR Tree

#### 7.3.1 Brief Description of an XOR Tree

An example of a generic XOR tree is shown in the [Figure 7-1](#) below.

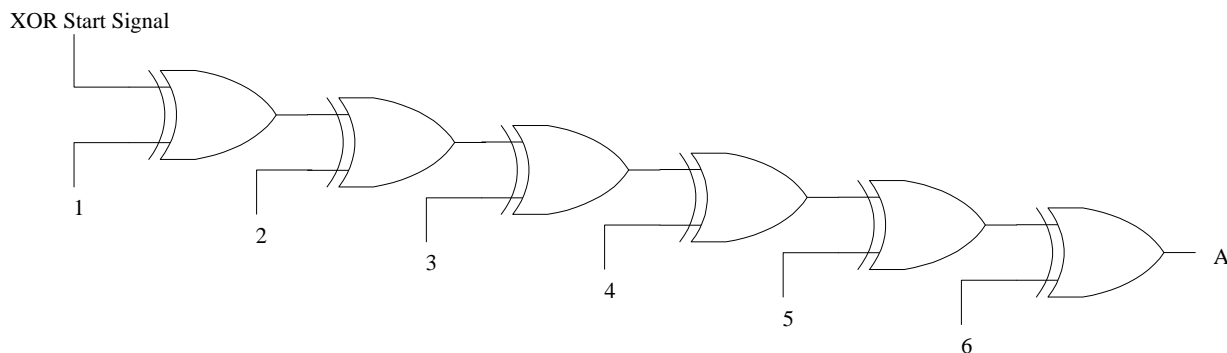


Figure 7-1 An Example of a Generic XOR Tree

Pin A is assigned to the output direction, and pins 1 through 6 are assigned to the input direction. It can be seen that after all pins 1 to 6 are assigned to logic 0 or 1, a logic change in any one of these pins will toggle the output pin A.

The following is the truth table for the XOR tree shown in [Figure 7-1](#). The XOR start signal is assumed to be logic 1.

Table 7-2 Example of an XOR Tree

Test Vector number	Input Pin 1	Input Pin 2	Input Pin 3	Input Pin 4	Input Pin 5	Input Pin 6	Output Pin A
1	0	0	0	0	0	0	1
2	1	0	0	0	0	0	0
3	1	1	0	0	0	0	1
4	1	1	1	0	0	0	0
5	1	1	1	1	0	0	1
6	1	1	1	1	1	0	0
7	1	1	1	1	1	1	1

### 7.3.2 Description of the XOR Tree for the M690T

The XOR start signal is applied at the TDI pin of the JTAG circuitry and the output of the XOR tree is obtained at the TDO pin. Refer to [Section 7.3.4](#) for the list of the signals included on the XOR tree. There is no specific connection order to the signals on the tree. A toggle of any of these balls in the XOR tree will cause the output to toggle.

### 7.3.3 XOR Tree Activation

The M690T chip enters the XOR tree test mode by means of the JTAG. First, the 8-bit instruction register of the JTAG is loaded with the XOR instruction (“00001000”). This instruction assigns the input direction to all the pins except pin TDO, which is assigned the output direction to serve as the output of the XOR tree. After loading, the JTAG is taken to the Run-Test state for completion of the XOR tree initialization.

**Note:** 10MHz clock frequency is recommended for the XOR TREE test mode.

### 7.3.4 XOR Chain for the M690T

When the XOR tree is activated, any pin on the XOR tree must be either pulled down or pulled up to the I/O voltage of the pin. Only pins that are **not** on the XOR tree can be left floating.

When differential signal pairs are listed as single entries on the XOR tree, opposite input values should be applied to the two signals in each pair (e.g., for entry no. 13 on the tree, when “1” is applied to HT\_RXCAD15P, “0” should be applied to HT\_RXCAD15N).

Table 7-3 M690T XOR Tree

No.	Pin Name	Ball Ref.
1	LVDS_BLON	G12
2	LVDS_BLEN	F12
3	LVDS_DIGON	E12
4	DACVSYNC	C6
5	DACHSYNC	A5
6	DACSCL	B6
7	DFT_GPIO0	D6
8	DFT_GPIO1	D7
9	DFT_GPIO2	C8
10	DFT_GPIO3	C7
11	DFT_GPIO4	B8
12	DFT_GPIO5	A8
13	HT_RXCAD15N/P	R18/R19
14	HT_RXCAD14N/P	R22/R21
15	HT_RXCAD13N/P	U21/U22
16	HT_RXCAD12N/P	U19/U18
17	HT_RXCAD11N/P	W20/W19
18	HT_RXCAD10N/P	AB22/AC21
19	HT_RXCAD9N/P	AA20/AB20
20	HT_RXCAD8N/P	Y19/AA19
21	HT_RXCAD7N/P	R25/T24
22	HT_RXCAD6N/P	U24/U25
23	HT_RXCAD5N/P	U23/V23
24	HT_RXCAD4N/P	V25/V24
25	HT_RXCAD3N/P	AA24/AA25
26	HT_RXCAD2N/P	AA23/AB23
27	HT_RXCAD1N/P	AB25/AB24
28	HT_RXCAD0N/P	AC25/AC24
29	HT_RXCTLN/P	P25/P24
30	HT_RXCLK1N/P	W22/W21
31	HT_RXCLK0N/P	W25/Y24
32	GPP_RX3N/P	R5/R4
33	GPP_RX2N/P	P5/P4
34	GPP_RX1N/P	U5/U4
35	GPP_RX0N/P	R8/R7

No.	Pin Name	Ball Ref.
36	SB_RX3N/P	W5/W4
37	SB_RX2N/P	Y5/Y4
38	SB_RX1N/P	W9/V9
39	SB_RX0N/P	AB6/AB7
40	GFX_RX7N/P	P7/P8
41	GFX_RX6N/P	M5/M4
42	GFX_RX5N/P	M7/M8
43	GFX_RX4N/P	L5/L4
44	GFX_RX3N/P	L7/L8
45	GFX_RX2N/P	J5/J4
46	GFX_RX1N/P	J7/J8
47	GFX_RX0N/P	G4/G5
48	MEM_DQS1N/P	AC20/AD21
49	MEM_DQS0N/P	AD17/AE17
50	MEM_DQ15	AE21
51	MEM_DQ14	AD20
52	MEM_DQ13	AE20
53	MEM_DQ12	AC19
54	MEM_DQ11	AE19
55	MEM_DQ10	AD18
56	MEM_DQ9	AC17
57	MEM_DQ8	AD16
58	MEM_DQ7	AE16
59	MEM_DQ6	AE15
60	MEM_DQ5	AD15
61	MEM_DQ4	AC15
62	MEM_DQ3	AD14
63	MEM_DQ2	AC13
64	MEM_DQ1	AE13
65	MEM_DQ0	AD13
66	MEM_DM1	AD19
67	MEM_DM0	AC16
68	MEM_A13	AA11
69	MEM_A12	AD9
70	MEM_A11	Y14

No.	Pin Name	Ball Ref.
71	MEM_A10	AE10
72	MEM_A9	AC9
73	MEM_A8	AA12
74	MEM_A7	AE9
75	MEM_A6	AB14
76	MEM_A5	AB15
77	MEM_A4	W14
78	MEM_A3	AB11
79	MEM_A2	AB12
80	MEM_A1	AD10
81	MEM_A0	W12
82	MEM_BA2	AD11
83	MEM_BA1	AE11
84	MEM_BA0	AC11
85	MEM_CAS#	Y15
86	MEM_RAS#	AA15
87	MEM_WE#	AC14
88	MEM_ODT	Y9
89	MEM_CS#	V12
90	MEM_CKE	AD12
91	MEM_CKN/P	V15/W15

## 7.4 VOH/VOL Test

### 7.4.1 Brief Description of a VOH/VOL Tree

The VOH/VOL logic gives signal output on I/Os when test patterns are applied through the TEST\_ODD and TEST\_EVEN inputs. Sample of a generic VOH/VOL tree is shown in the [Figure 7-2](#) below.

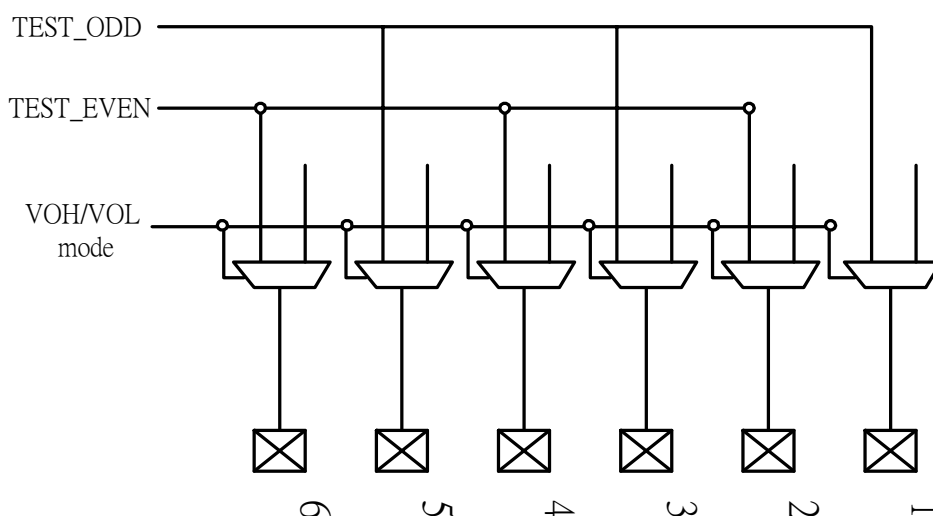


Figure 7-2 Sample of a Generic VOH/VOL Tree

The following is the truth table for the above VOH/VOL tree.

Table 7-4 Truth Table for the VOH/VOL Tree Outputs

Test Vector Number	TEST_ODD Input	TEST_EVEN Input	Output Pin 1	Output Pin 2	Output Pin 3	Output Pin 4	Output Pin 5	Output Pin 6
1	0	0	0	0	0	0	0	0
2	0	1	0	1	0	1	0	1
3	1	0	1	0	1	0	1	0
4	1	1	1	1	1	1	1	1

Refer to [Table 7.4.3, “VOH/VOL Pin List,” on page 7-6](#) for the list of pins that are on the VOH/VOL tree.

## 7.4.2 VOH/VOL Tree Activation

To activate the VOH/VOL tree and run a VOH/VOL test, perform the sequence below:

1. Supply a clock at any speed (same or faster than test pattern data rate) to the OSCIN pin as the I/O test clock source.
2. Set POWERGOOD to 0.
3. Set TESTMODE to 1.
4. Set DACSDA to 0.
5. Load JTAG instruction register with the instruction 0110 0011.
6. Load JTAG instruction register with the instruction 0010 0111.
7. Set POWERGOOD to 1.

8. Load JTAG instruction register with the instruction 1001 1001.
9. Run test by loading JTAG data register with data 0000 0000 0000 00xy, where bit x is the input value for TEST\_ODD and bit y that for TEST\_EVEN (see Table 7-4 above).
10. To end test, load JTAG instruction register with the instruction 0101 1101.

### 7.4.3 VOH/VOL Pin List

Table 7-5 below shows the M690T VOH/VOL tree. There is no specific order of connection. Under the Control column, an “ODD” or “EVEN” indicates that the logical output of the pin is same as the “TEST\_ODD” or “TEST\_EVEN” input respectively.

When a differential pair appear in the table as a single entry, the output of the positive (“P”) pin is indicated in the Control column (see last paragraph for explanations), and the output of the negative pin (“N”) will be of the opposite value. E.g., for entry no. 1 on the tree, when TEST\_EVEN is 1, HT\_TXCAD15P will give a value of 1 and HT\_TXCAD15N will give a value of 0.

**Table 7-5 M690T VOH/VOL Tree**

No.	Pin Name	Ball Ref.	Control
1	HT_TXCAD15P/N	P21/P22	EVEN
2	HT_TXCAD14P/N	P18/P19	ODD
3	HT_TXCAD13P/N	M22/M21	EVEN
4	HT_TXCAD12P/N	M18/M19	ODD
5	HT_TXCAD11P/N	L18/L19	EVEN
6	HT_TXCAD10P/N	G22/G21	ODD
7	HT_TXCAD9P/N	J20/J21	EVEN
8	HT_TXCAD8P/N	F21/F22	ODD
9	HT_TXCTLN	N23/P23	EVEN
10	HT_TXCAD7P/N	N24/N25	ODD
11	HT_TXCAD6P/N	L25/M24	EVEN
12	HT_TXCAD5P/N	K25/K24	ODD
13	HT_TXCAD4P/N	J23/K23	EVEN
14	HT_TXCAD3P/N	G25/H24	ODD
15	HT_TXCAD2P/N	F25/F24	EVEN
16	HT_TXCAD1P/N	E23/F23	ODD
17	HT_TXCAD0P/N	E24/E25	EVEN
18	DACSCL	B6	ODD
19	DACVSYNC	C6	EVEN
20	DACHSYNC	A5	ODD
21	LVDS_BLON	G12	EVEN
22	LVDS_BLEN	F12	ODD
23	LVDS_DIGON	E12	EVEN

No.	Pin Name	Ball Ref.	Control
24	DFT_GPIO5	A8	ODD
25	DFT_GPIO4	B8	EVEN
26	DFT_GPIO3	C7	ODD
27	DFT_GPIO2	C8	EVEN
28	DFT_GPIO1	D7	ODD
29	DFT_GPIO0	D6	EVEN
30	SB_TX3P/N	Y2/Y3	ODD
31	SB_TX2P/N	AA1/AA2	EVEN
32	SB_TX1P/N	AB1/AB2	ODD
33	SB_TX0P/N	AC1/AC2	EVEN
34	GPP_TX3P/N	V2/V1	ODD
35	GPP_TX2P/N	U2/U1	EVEN
36	GPP_TX1P/N	W1/W2	ODD
37	GPP_TX0P/N	V3/W3	EVEN
38	GFX_TX7P/N	R1/R2	ODD
39	GFX_TX6P/N	P3/R3	EVEN
40	GFX_TX5P/N	P2/P1	ODD
41	GFX_TX4P/N	N2/N1	EVEN
42	GFX_TX3P/N	L1/L2	ODD
43	GFX_TX2P/N	K3/L3	EVEN
44	GFX_TX1P/N	K2/K1	ODD
45	GFX_TX0P/N	J1/H2	EVEN
46	MEM_DQS1P	AD21	ODD

No.	Pin Name	Ball Ref.	Control
47	MEM_DQS1N	AC20	EVEN
48	MEM_DQS0N	AD17	ODD
49	MEM_DQS0P	AE17	EVEN
50	MEM_DQ12	AC19	ODD
51	MEM_DQ15	AE21	EVEN
52	MEM_DQ11	AE19	ODD
53	MEM_DQ14	AD20	EVEN
54	MEM_CS#	V12	ODD
55	MEM_DQ13	AE20	EVEN
56	MEM_DQ10	AD18	ODD
57	MEM_DQ9	AC17	EVEN
58	MEM_DQ8	AD16	ODD
59	MEM_DQ7	AE16	EVEN
60	MEM_DQ6	AE15	ODD
61	MEM_DQ5	AD15	EVEN
62	MEM_DQ2	AC13	ODD
63	MEM_DQ4	AC15	EVEN
64	MEM_DQ1	AE13	ODD
65	MEM_DQ3	AD14	EVEN
66	MEM_DQ0	AD13	ODD
67	MEM_DM1	AD19	EVEN
68	MEM_DM0	AC16	ODD
69	MEM_A13	AA11	EVEN
70	MEM_A12	AD9	ODD
71	MEM_A11	Y14	EVEN
72	MEM_A10	AE10	ODD
73	MEM_A9	AC9	EVEN
74	MEM_A8	AA12	ODD
75	MEM_A7	AE9	EVEN
76	MEM_A6	AB14	ODD
77	MEM_A5	AB15	EVEN
78	MEM_A4	W14	ODD
79	MEM_A3	AB11	EVEN
80	MEM_A2	AB12	ODD
81	MEM_A1	AD10	EVEN
82	MEM_A0	W12	ODD

No.	Pin Name	Ball Ref.	Control
83	MEM_BA2	AD11	EVEN
84	MEM_BA1	AE11	ODD
85	MEM_BA0	AC11	EVEN
86	MEM_CAS#	Y15	ODD
87	MEM_RAS#	AA15	EVEN
88	MEM_WE#	AC14	ODD
89	MEM_ODT	Y9	EVEN
90	MEM_CKE	AD12	ODD
91	MEM_CKP/N	W15/V15	EVEN

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# Appendix A

## *Pin Listings*

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This appendix contains pin listings for the M690T sorted in different ways. To go to the listing of interest, use the linked cross-references below:

[\*“M690T Pin List Sorted by Ball Reference” on page A-2\*](#)

[\*“M690T Pin List Sorted by Pin Name” on page A-6\*](#)

## A.1 M690T Pin List Sorted by Ball Reference

**Table A-1 M690T Pin List Sorted by Ball Reference**

Ball Ref.	Pin Name	Ball Ref.	Pin Name	Ball Ref.	Pin Name
A1	VSSA	AB11	MEM_A3	AC9	MEM_A9
A10	PLLVD18	AB12	MEM_A2	AD1	VSSA
A11	PLLVD12	AB14	MEM_A6	AD10	MEM_A1
A12	LVDDR18D	AB15	MEM_A5	AD11	MEM_BA2
A13	TXOUT_L1N	AB17	IOPLLVD12	AD12	MEM_CKE
A14	LVSSR	AB19	VSS	AD13	MEM_DQ0
A15	TXOUT_U0P	AB2	SB_TX1N	AD14	MEM_DQ3
A16	LVSSR	AB20	HT_RXCAD9P	AD15	MEM_DQ5
A17	TXOUT_U2N	AB22	HT_RXCAD10N	AD16	MEM_DQ8
A18	TXOUT_U3P	AB23	HT_RXCAD2P	AD17	MEM_DQS0N
A19	VDD_CORE	AB24	HT_RXCAD1P	AD18	MEM_DQ10
A2	I2C_CLK	AB25	HT_RXCAD1N	AD19	MEM_DM1
A20	AVDDDI	AB3	VDDA_12	AD2	VDDA_12
A21	AVDDQ	AB4	VDDA_12	AD20	MEM_DQ14
A22	AVSSQ	AB6	SB_RX0N	AD21	MEM_DQS1P
A23	VSS	AB7	SB_RX0P	AD22	VDD_HT
A24	HT_RXCALP	AB9	VDD_MEM	AD23	VDD_HT
A25	VSS	AC1	SB_TX0P	AD24	VDD_HT
A3	STRP_DATA	AC10	VSS	AD25	VSS
A4	VDD_CORE	AC11	MEM_BA0	AD3	VDDA_12_PKG
A5	DACHSYNC	AC12	VSS	AD4	NC
A6	DACSDA	AC13	MEM_DQ2	AD5	THERMALDIODE_P
A7	VDD_CORE	AC14	MEM_WE#	AD6	VDD_MEM
A8	DFT_GPIO5	AC15	MEM_DQ4	AD7	VDD_MEM
A9	VDD_CORE	AC16	MEM_DM0	AD8	VDD_MEM
AA1	SB_TX2P	AC17	MEM_DQ9	AD9	MEM_A12
AA11	MEM_A13	AC18	VSS	AE1	VSSA
AA12	MEM_A8	AC19	MEM_DQ12	AE10	MEM_A10
AA14	VSS	AC2	SB_TX0N	AE11	MEM_BA1
AA15	MEM_RAS#	AC20	MEM_DQS1N	AE12	MEM_VREF
AA17	IOPLLVD18	AC21	HT_RXCAD10P	AE13	MEM_DQ1
AA19	HT_RXCAD8P	AC22	VSS	AE14	VSS
AA2	SB_TX2N	AC23	VSS	AE15	MEM_DQ6
AA20	HT_RXCAD9N	AC24	HT_RXCAD0P	AE16	MEM_DQ7
AA23	HT_RXCAD2N	AC25	HT_RXCAD0N	AE17	MEM_DQS0P
AA24	HT_RXCAD3N	AC3	VDDA_12	AE18	VSS
AA25	HT_RXCAD3P	AC4	NC	AE19	MEM_DQ11
AA3	VSSA	AC5	VDDA_12	AE2	VDDA_12
AA7	VSSA	AC6	VSSA	AE20	MEM_DQ13
AA9	VDD_MEM	AC7	VDD_MEM	AE21	MEM_DQ15
AB1	SB_TX1P	AC8	VDD_MEM	AE22	VDD_HT

Ball Ref.	Pin Name
AE23	VDD_HT
AE24	VDD_HT
AE25	VDD_HT
AE3	PCE_CALRN
AE4	PCE_CALRP
AE5	THERMALDIODE_N
AE6	VDD_MEM
AE7	VDD_MEM
AE8	VDD_MEM
AE9	MEM_A7
B1	VDDA_12
B10	PLLSS
B11	OSCIN
B12	LVDDR18D
B13	TXOUT_L1P
B14	TXOUT_L0P
B15	TXOUT_L0N
B16	TXOUT_U0N
B17	TXOUT_U2P
B18	TXOUT_U3N
B19	VDD_CORE
B2	BMREQ#
B20	AVSSDI
B21	RSET
B22	AVDD
B23	HTREFCLK
B24	HTPVDD
B25	HTPVSS
B3	DDC_DATA
B4	I2C_DATA
B5	ALLOW_LDTSTOP
B6	DACSCL
B7	VSS
B8	DFT_GPIO4
B9	VDD_CORE
C1	VDDA_12
C10	SYSRESET#
C11	POWERGOOD
C12	LVDDR33
C13	LVDDR33
C14	TMDS_HPD
C15	LVSSR
C16	LVSSR

Ball Ref.	Pin Name
C17	TXOUT_U1P
C18	TXOUT_U1N
C19	LVSSR
C2	TVCLKIN
C20	Y
C21	C
C22	AVDD
C23	HTTSTCLK
C24	HT_RXCALN
C25	HT_TXCALP
C3	TESTMODE
C4	VSS
C5	LDTSTOP#
C6	DACVSYNC
C7	DFT_GPIO3
C8	DFT_GPIO2
C9	VDD_CORE
D1	VDDA_12
D11	VDDR3
D12	LVSSR
D14	LPVDD
D15	TXCLK_LN
D17	TXOUT_L3P
D19	COMP
D2	VDDA_12
D20	VDD_CORE
D22	VDD_HT_PKG
D23	VSS
D24	HT_TXCALN
D25	VSS
D3	VDDA_12
D4	VSS
D6	DFT_GPIO0
D7	DFT_GPIO1
D9	VDD_CORE
E1	GFX_CLKN
E11	VDDR3
E12	LVDS_DIGON
E14	LPVSS
E15	TXCLK_LP
E17	TXOUT_L3N
E19	RED
E2	VDDA_12

Ball Ref.	Pin Name
E23	HT_TXCAD1P
E24	HT_TXCAD0P
E25	HT_TXCAD0N
E3	VDDA_12
E6	VDDA_12
E7	VDD_PLL
E9	VSS
F1	VSSA
F11	VSS
F12	LVDS_BLEN
F14	LVSSR
F15	LVSSR
F17	VSS
F19	GREEN
F2	GFX_CLKP
F21	HT_TXCAD8P
F22	HT_TXCAD8N
F23	HT_TXCAD1N
F24	HT_TXCAD2N
F25	HT_TXCAD2P
F3	VSSA
F4	VDDA_12
F7	VDD_PLL
F9	VSS_PLL
G1	SB_CLKP
G11	VSS
G12	LVDS_BLON
G14	TXOUT_L2N
G15	TXCLK_UN
G17	AVSSN
G19	BLUE
G2	SB_CLKN
G20	VDD_CORE
G21	HT_TXCAD10N
G22	HT_TXCAD10P
G23	VSS
G24	VSS
G25	HT_TXCAD3P
G3	VSSA
G4	GFX_RX0N
G5	GFX_RX0P
G6	VSSA
G7	VDDA_12

Ball Ref.	Pin Name
G9	VSS_PLL
H1	VSSA
H11	VDD_CORE
H12	VSS
H14	TXOUT_L2P
H15	TXCLK_UP
H17	AVSSN
H2	GFX_TX0N
H23	VSS
H24	HT_TXCAD3N
H25	VSS
H3	VSSA
J1	GFX_TX0P
J11	VDD_CORE
J12	VSS
J14	VDD_18
J15	VDD_18
J19	VDD_CORE
J2	VSSA
J20	HT_TXCAD9P
J21	HT_TXCAD9N
J22	VSS
J23	HT_TXCAD4P
J24	HT_TXCLK0P
J25	HT_TXCLK0N
J3	VSSA
J4	GFX_RX2P
J5	GFX_RX2N
J6	VSSA
J7	GFX_RX1N
J8	GFX_RX1P
K1	GFX_TX1N
K2	GFX_TX1P
K23	HT_TXCAD4N
K24	HT_TXCAD5N
K25	HT_TXCAD5P
K3	GFX_TX2P
L1	GFX_TX3P
L11	VDD_CORE
L12	VSS
L13	VDD_CORE
L14	VSS
L15	VDD_CORE
L17	VDD_CORE

Ball Ref.	Pin Name
L18	HT_TXCAD11P
L19	HT_TXCAD11N
L2	GFX_TX3N
L20	VSS
L21	HT_TXCLK1P
L22	HT_TXCLK1N
L23	VSS
L24	VSS
L25	HT_TXCAD6P
L3	GFX_TX2N
L4	GFX_RX4P
L5	GFX_RX4N
L6	VSSA
L7	GFX_RX3N
L8	GFX_RX3P
L9	VDDA_12
M1	VDDA_12_PKG
M11	VSS
M12	VDD_CORE
M13	VSS
M14	VDD_CORE
M15	VSS
M17	VSS
M18	HT_TXCAD12P
M19	HT_TXCAD12N
M2	VSSA
M20	VSS
M21	HT_TXCAD13N
M22	HT_TXCAD13P
M23	VSS
M24	HT_TXCAD6N
M25	VSS
M3	VSSA
M4	GFX_RX6P
M5	GFX_RX6N
M6	VSSA
M7	GFX_RX5N
M8	GFX_RX5P
M9	VDDA_12
N1	GFX_TX4N
N11	VDD_CORE
N12	VSS
N13	VDD_CORE
N14	VSS

Ball Ref.	Pin Name
N15	VDD_CORE
N2	GFX_TX4P
N23	HT_TXCTLP
N24	HT_TXCAD7P
N25	HT_TXCAD7N
N3	VSSA
P1	GFX_TX5N
P11	VSS
P12	VDD_CORE
P13	VSS
P14	VDD_CORE
P15	VSS
P17	VDD_CORE
P18	HT_TXCAD14P
P19	HT_TXCAD14N
P2	GFX_TX5P
P20	VSS
P21	HT_TXCAD15P
P22	HT_TXCAD15N
P23	HT_TXCTLN
P24	HT_RXCTLP
P25	HT_RXCTLN
P3	GFX_TX6P
P4	GPP_RX2P
P5	GPP_RX2N
P6	VSSA
P7	GFX_RX7N
P8	GFX_RX7P
P9	VSSA
R1	GFX_TX7P
R11	VDD_CORE
R12	VSS
R13	VDD_CORE
R14	VSS
R15	VDD_CORE
R17	VSS
R18	HT_RXCAD15N
R19	HT_RXCAD15P
R2	GFX_TX7N
R20	VSS
R21	HT_RXCAD14P
R22	HT_RXCAD14N
R23	VSS
R24	VSS

Ball Ref.	Pin Name
R25	HT_RXCAD7N
R3	GFX_TX6N
R4	GPP_RX3P
R5	GPP_RX3N
R6	VSSA
R7	GPP_RX0P
R8	GPP_RX0N
R9	VSSA
T1	VSSA
T2	VSSA
T23	VSS
T24	HT_RXCAD7P
T25	VSS
T3	VSSA
U1	GPP_TX2N
U11	VDD_CORE
U12	VDD_CORE
U14	VDD_CORE
U15	VDD_CORE
U18	HT_RXCAD12P
U19	HT_RXCAD12N
U2	GPP_TX2P
U20	VSS
U21	HT_RXCAD13N
U22	HT_RXCAD13P
U23	HT_RXCAD5N
U24	HT_RXCAD6N
U25	HT_RXCAD6P
U3	VSSA
U4	GPP_RX1P
U5	GPP_RX1N
U6	VSSA
U7	VDDA_12
V1	GPP_TX3N
V11	VSS
V12	MEM_CS#
V14	VSS
V15	MEM_CKN
V2	GPP_TX3P
V23	HT_RXCAD5P
V24	HT_RXCAD4P
V25	HT_RXCAD4N
V3	GPP_TX0P

Ball Ref.	Pin Name
V9	SB_RX1P
W1	GPP_TX1P
W11	MEM_COMPN
W12	MEM_A0
W14	MEM_A4
W15	MEM_CKP
W17	VSS
W19	HT_RXCAD11P
W2	GPP_TX1N
W20	HT_RXCAD11N
W21	HT_RXCLK1P
W22	HT_RXCLK1N
W23	VSS
W24	VSS
W25	HT_RXCLK0N
W3	GPP_TX0N
W4	SB_RX3P
W5	SB_RX3N
W6	VSSA
W7	VDDA_12
W9	SB_RX1N
Y1	VSSA
Y11	MEM_COMPP
Y12	VSS
Y14	MEM_A11
Y15	MEM_CAS#
Y17	IOPLL_VSS
Y19	HT_RXCAD8N
Y2	SB_TX3P
Y22	VSS
Y23	VSS
Y24	HT_RXCLK0P
Y25	VSS
Y3	SB_TX3N
Y4	SB_RX2P
Y5	SB_RX2N
Y7	VSSA
Y9	MEM_ODT

## A.2 M690T Pin List Sorted by Pin Name

Table A-2 M690T Pin List Sorted by Pin Name

Pin Name	Ball Ref.	Pin Name	Ball Ref.	Pin Name	Ball Ref.
ALLOW_LDTSTOP	B5	GFX_RX7P	P8	HT_RXCAD12P	U18
AVDD	B22	GFX_TX0N	H2	HT_RXCAD13N	U21
AVDD	C22	GFX_TX0P	J1	HT_RXCAD13P	U22
AVDDDI	A20	GFX_TX1N	K1	HT_RXCAD14N	R22
AVDDQ	A21	GFX_TX1P	K2	HT_RXCAD14P	R21
AVSSDI	B20	GFX_TX2N	L3	HT_RXCAD15N	R18
AVSSN	G17	GFX_TX2P	K3	HT_RXCAD15P	R19
AVSSN	H17	GFX_TX3N	L2	HT_RXCAD1N	AB25
AVSSQ	A22	GFX_TX3P	L1	HT_RXCAD1P	AB24
BLUE	G19	GFX_TX4N	N1	HT_RXCAD2N	AA23
BMREQ#	B2	GFX_TX4P	N2	HT_RXCAD2P	AB23
C	C21	GFX_TX5N	P1	HT_RXCAD3N	AA24
COMP	D19	GFX_TX5P	P2	HT_RXCAD3P	AA25
DACHSYNC	A5	GFX_TX6N	R3	HT_RXCAD4N	V25
DACSCL	B6	GFX_TX6P	P3	HT_RXCAD4P	V24
DACSDA	A6	GFX_TX7N	R2	HT_RXCAD5N	U23
DACVSYNC	C6	GFX_TX7P	R1	HT_RXCAD5P	V23
DDC_DATA	B3	GPP_RX0N	R8	HT_RXCAD6N	U24
DFT_GPIO0	D6	GPP_RX0P	R7	HT_RXCAD6P	U25
DFT_GPIO1	D7	GPP_RX1N	U5	HT_RXCAD7N	R25
DFT_GPIO2	C8	GPP_RX1P	U4	HT_RXCAD7P	T24
DFT_GPIO3	C7	GPP_RX2N	P5	HT_RXCAD8N	Y19
DFT_GPIO4	B8	GPP_RX2P	P4	HT_RXCAD8P	AA19
DFT_GPIO5	A8	GPP_RX3N	R5	HT_RXCAD9N	AA20
GFX_CLKN	E1	GPP_RX3P	R4	HT_RXCAD9P	AB20
GFX_CLKP	F2	GPP_TX0N	W3	HT_RXCALN	C24
GFX_RX0N	G4	GPP_TX0P	V3	HT_RXCALP	A24
GFX_RX0P	G5	GPP_TX1N	W2	HT_RXCLK0N	W25
GFX_RX1N	J7	GPP_TX1P	W1	HT_RXCLK0P	Y24
GFX_RX1P	J8	GPP_TX2N	U1	HT_RXCLK1N	W22
GFX_RX2N	J5	GPP_TX2P	U2	HT_RXCLK1P	W21
GFX_RX2P	J4	GPP_TX3N	V1	HT_RXCTLN	P25
GFX_RX3N	L7	GPP_TX3P	V2	HT_RXCTLP	P24
GFX_RX3P	L8	GREEN	F19	HT_TXCAD0N	E25
GFX_RX4N	L5	HT_RXCAD0N	AC25	HT_TXCAD0P	E24
GFX_RX4P	L4	HT_RXCAD0P	AC24	HT_TXCAD10N	G21
GFX_RX5N	M7	HT_RXCAD10N	AB22	HT_TXCAD10P	G22
GFX_RX5P	M8	HT_RXCAD10P	AC21	HT_TXCAD11N	L19
GFX_RX6N	M5	HT_RXCAD11N	W20	HT_TXCAD11P	L18
GFX_RX6P	M4	HT_RXCAD11P	W19	HT_TXCAD12N	M19
GFX_RX7N	P7	HT_RXCAD12N	U19	HT_TXCAD12P	M18

Pin Name	Ball Ref.
HT_TXCAD13N	M21
HT_TXCAD13P	M22
HT_TXCAD14N	P19
HT_TXCAD14P	P18
HT_TXCAD15N	P22
HT_TXCAD15P	P21
HT_TXCAD1N	F23
HT_TXCAD1P	E23
HT_TXCAD2N	F24
HT_TXCAD2P	F25
HT_TXCAD3N	H24
HT_TXCAD3P	G25
HT_TXCAD4N	K23
HT_TXCAD4P	J23
HT_TXCAD5N	K24
HT_TXCAD5P	K25
HT_TXCAD6N	M24
HT_TXCAD6P	L25
HT_TXCAD7N	N25
HT_TXCAD7P	N24
HT_TXCAD8N	F22
HT_TXCAD8P	F21
HT_TXCAD9N	J21
HT_TXCAD9P	J20
HT_TXCALN	D24
HT_TXCALP	C25
HT_TXCLK0N	J25
HT_TXCLK0P	J24
HT_TXCLK1N	L22
HT_TXCLK1P	L21
HT_TXCTLN	P23
HT_TXCTLP	N23
HTPVDD	B24
HTPVSS	B25
HTREFCLK	B23
HTTSTCLK	C23
I2C_CLK	A2
I2C_DATA	B4
IOPLLVD12	AB17
IOPLLVD18	AA17
IOPLLVSS	Y17
LDTSTOP#	C5
LPVDD	D14

Pin Name	Ball Ref.
LPVSS	E14
LVDDR18D	A12
LVDDR18D	B12
LVDDR33	C12
LVDDR33	C13
LVDS_BLEN	F12
LVDS_BLON	G12
LVDS_DIGON	E12
LVSSR	A14
LVSSR	A16
LVSSR	C15
LVSSR	C16
LVSSR	C19
LVSSR	D12
LVSSR	F14
LVSSR	F15
MEM_A0	W12
MEM_A1	AD10
MEM_A10	AE10
MEM_A11	Y14
MEM_A12	AD9
MEM_A13	AA11
MEM_A2	AB12
MEM_A3	AB11
MEM_A4	W14
MEM_A5	AB15
MEM_A6	AB14
MEM_A7	AE9
MEM_A8	AA12
MEM_A9	AC9
MEM_BA0	AC11
MEM_BA1	AE11
MEM_BA2	AD11
MEM_CAS#	Y15
MEM_CKE	AD12
MEM_CKN	V15
MEM_CKP	W15
MEM_COMPN	W11
MEM_COMPN	Y11
MEM_CS#	V12
MEM_DM0	AC16
MEM_DM1	AD19
MEM_DQ0	AD13

Pin Name	Ball Ref.
MEM_DQ1	AE13
MEM_DQ10	AD18
MEM_DQ11	AE19
MEM_DQ12	AC19
MEM_DQ13	AE20
MEM_DQ14	AD20
MEM_DQ15	AE21
MEM_DQ2	AC13
MEM_DQ3	AD14
MEM_DQ4	AC15
MEM_DQ5	AD15
MEM_DQ6	AE15
MEM_DQ7	AE16
MEM_DQ8	AD16
MEM_DQ9	AC17
MEM_DQS0N	AD17
MEM_DQS0P	AE17
MEM_DQS1N	AC20
MEM_DQS1P	AD21
MEM_ODT	Y9
MEM_RAS#	AA15
MEM_VREF	AE12
MEM_WE#	AC14
NC	AC4
NC	AD4
OSCIN	B11
PCE_CALRN	AE3
PCE_CALRP	AE4
PLLVD12	A11
PLLVD18	A10
PLLVSS	B10
POWERGOOD	C11
RED	E19
RSET	B21
SB_CLKN	G2
SB_CLKP	G1
SB_RX0N	AB6
SB_RX0P	AB7
SB_RX1N	W9
SB_RX1P	V9
SB_RX2N	Y5
SB_RX2P	Y4
SB_RX3N	W5

Pin Name	Ball Ref.
SB_RX3P	W4
SB_TX0N	AC2
SB_TX0P	AC1
SB_TX1N	AB2
SB_TX1P	AB1
SB_TX2N	AA2
SB_TX2P	AA1
SB_TX3N	Y3
SB_TX3P	Y2
STRP_DATA	A3
SYSRESET#	C10
TESTMODE	C3
THERMALDIODE_N	AE5
THERMALDIODE_P	AD5
TMDS_HPD	C14
TVCLKIN	C2
TXCLK_LN	D15
TXCLK_LP	E15
TXCLK_UN	G15
TXCLK_UP	H15
TXOUT_L0N	B15
TXOUT_L0P	B14
TXOUT_L1N	A13
TXOUT_L1P	B13
TXOUT_L2N	G14
TXOUT_L2P	H14
TXOUT_L3N	E17
TXOUT_L3P	D17
TXOUT_U0N	B16
TXOUT_U0P	A15
TXOUT_U1N	C18
TXOUT_U1P	C17
TXOUT_U2N	A17
TXOUT_U2P	B17
TXOUT_U3N	B18
TXOUT_U3P	A18
VDD_18	J14
VDD_18	J15
VDD_CORE	A19
VDD_CORE	A4
VDD_CORE	A7
VDD_CORE	A9
VDD_CORE	B19
VDD_CORE	B9

Pin Name	Ball Ref.
VDD_CORE	C9
VDD_CORE	D20
VDD_CORE	D9
VDD_CORE	G20
VDD_CORE	H11
VDD_CORE	J11
VDD_CORE	J19
VDD_CORE	L11
VDD_CORE	L13
VDD_CORE	L15
VDD_CORE	L17
VDD_CORE	M12
VDD_CORE	M14
VDD_CORE	N11
VDD_CORE	N13
VDD_CORE	N15
VDD_CORE	P12
VDD_CORE	P14
VDD_CORE	P17
VDD_CORE	R11
VDD_CORE	R13
VDD_CORE	R15
VDD_CORE	U11
VDD_CORE	U12
VDD_CORE	U14
VDD_CORE	U15
VDD_HT	AD22
VDD_HT	AD23
VDD_HT	AD24
VDD_HT	AE22
VDD_HT	AE23
VDD_HT	AE24
VDD_HT	AE25
VDD_HT_PKG	D22
VDD_MEM	AA9
VDD_MEM	AB9
VDD_MEM	AC7
VDD_MEM	AC8
VDD_MEM	AD6
VDD_MEM	AD7
VDD_MEM	AD8
VDD_MEM	AE6
VDD_MEM	AE7
VDD_MEM	AE8

Pin Name	Ball Ref.
VDD_PLL	E7
VDD_PLL	F7
VDDA_12	AB3
VDDA_12	AB4
VDDA_12	AC3
VDDA_12	AC5
VDDA_12	AD2
VDDA_12	AE2
VDDA_12	B1
VDDA_12	C1
VDDA_12	D1
VDDA_12	D2
VDDA_12	D3
VDDA_12	E2
VDDA_12	E3
VDDA_12	E6
VDDA_12	F4
VDDA_12	G7
VDDA_12	L9
VDDA_12	M9
VDDA_12	U7
VDDA_12	W7
VDDA_12_PKG	AD3
VDDA_12_PKG	M1
VDDR3	D11
VDDR3	E11
VSS	A23
VSS	A25
VSS	AA14
VSS	AB19
VSS	AC10
VSS	AC12
VSS	AC18
VSS	AC22
VSS	AC23
VSS	AD25
VSS	AE14
VSS	AE18
VSS	B7
VSS	C4
VSS	D23
VSS	D25
VSS	D4
VSS	E9



Pin Name	Ball Ref.
VSS	F11
VSS	F17
VSS	G11
VSS	G23
VSS	G24
VSS	H12
VSS	H23
VSS	H25
VSS	J12
VSS	J22
VSS	L12
VSS	L14
VSS	L20
VSS	L23
VSS	L24
VSS	M11
VSS	M13
VSS	M15
VSS	M17
VSS	M20
VSS	M23
VSS	M25
VSS	N12
VSS	N14
VSS	P11
VSS	P13
VSS	P15
VSS	P20
VSS	R12
VSS	R14
VSS	R17
VSS	R20
VSS	R23
VSS	R24
VSS	T23
VSS	T25
VSS	U20
VSS	V11
VSS	V14
VSS	W17
VSS	W23
VSS	W24
VSS	Y12

Pin Name	Ball Ref.
VSS	Y22
VSS	Y23
VSS	Y25
VSS_PLL	F9
VSS_PLL	G9
VSSA	A1
VSSA	AA3
VSSA	AA7
VSSA	AC6
VSSA	AD1
VSSA	AE1
VSSA	F1
VSSA	F3
VSSA	G3
VSSA	G6
VSSA	H1
VSSA	H3
VSSA	J2
VSSA	J3
VSSA	J6
VSSA	L6
VSSA	M2
VSSA	M3
VSSA	M6
VSSA	N3
VSSA	P6
VSSA	P9
VSSA	R6
VSSA	R9
VSSA	T1
VSSA	T2
VSSA	T3
VSSA	U3
VSSA	U6
VSSA	W6
VSSA	Y1
VSSA	Y7
Y	C20

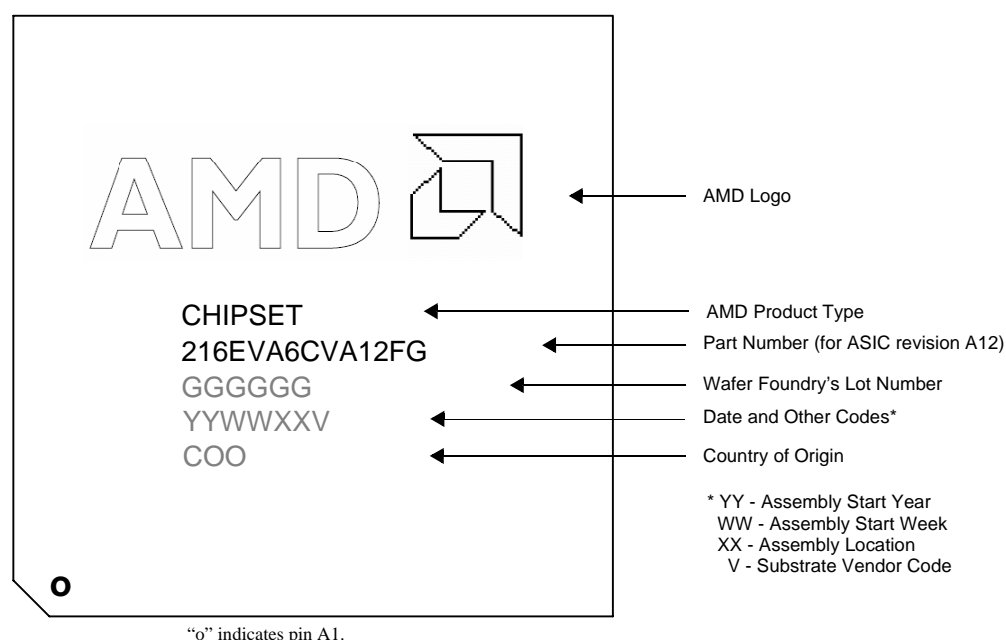
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# Appendix B

## AMD

### B.1 Introduction

The M690T and M690E are two members of the same AMD RS690-series Northbridge and chipset family. The M690E and M690T have exactly the same package, pin-out, and fabrication process. All peripheral functions and features are the same as well, except for the differences explained in [Section B.2](#) below.



**Figure B-1 M690E Branding Diagram for ASIC Revision A12**

Both the M690E and M690T are packaged in the same 21mmx21mm 465-ball FCBGA package. But, the devices' markings and part numbers are different. The part marking, planned production schedule, and AMD OPN (ordering number) for the M690E are shown in [Table B-1](#).

**Table B-1 Planned Production Schedule, OPN, and Part Marking**

Component	Production Availability Date	OPN	Part Marking
M690E	Oct 19, 2007	100-CG1408	216EVA6CVA12FG

### B.2 Feature Differences between the M690T and M690E

The M690E is identified and distinguished from the M690T by an e-fuse on the chip. There are no identification registers that differentiate the two devices.

#### A) TV Output

The M690T provides SDTV (PAL or NTSC standard, with composite, S-Video (separate luminance and chrominance channels), or YCbCr 480i (YUV) standard definition component output) and HDTV (YPbPr 480i, 480p, 576i, 576p, 720p, 1080i) outputs through the on-chip DACs that are shared between TV and CRT outputs. Macrovision analog TV copy protection is supported on all its standard definition and 480p high definition TV outputs.

The M690E, on the other hand, does not provide any sort of analog TV output and does not support Macrovision copy protection. Despite the lack of TV output, the DACs of the M690E can still be used to provide a high quality CRT output.

The table and figure below summarize the differences between the M690T and M690E in terms of analog TV and VGA/CRT display outputs.

**Table B-2 M690T/E Analog TV and VGA/CRT Support Differences**

Analog Output Feature	M690T	M690E
Composite NTSC/PAL TV Port	Available	Not Available
S-Video (Y/C) NTSC/PAL TV Port	Available	Not Available
Component 480i/576i (YUV/YCbCr) TV Port	Available	Not Available
Component 480p/576p/720p/1080i HDTV (YPbPr) TV Port	Available	Not Available
Standard VGA/CRT (RGBHV) Port	Available	Available

**Note:** AMD customers MUST have a Macrovision license in place or be authorized by Macrovision to purchase Macrovision-enabled technology before AMD can sell them any M690T chips. M690E devices can be obtained without a Macrovision license.

**Figure B-2 M690T and M690E Analog Display Output Signals**

**Note:** For designs using the M690E, the C, Y, and COMP pins on the package do not provide any output and should be left unconnected on the motherboard.

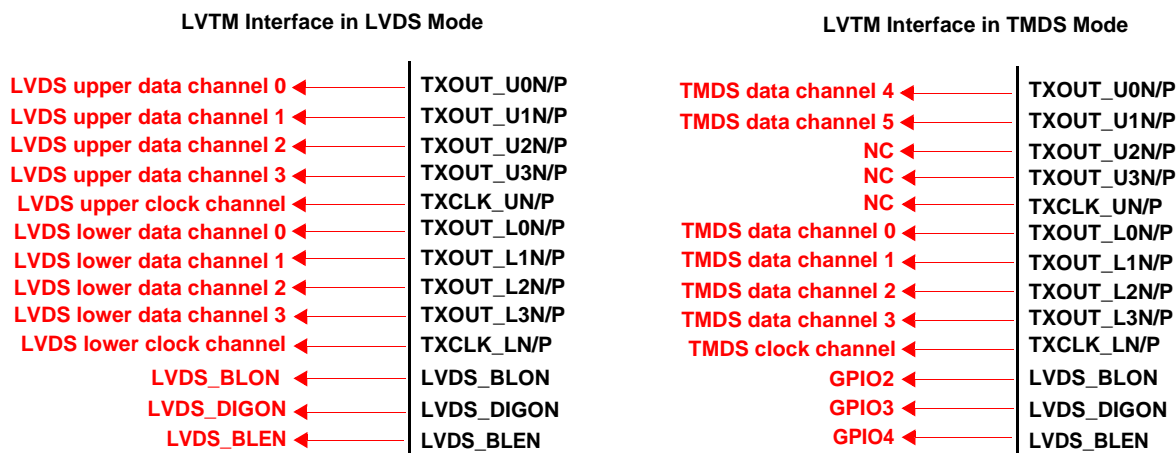
## B) TMDS/DVI Digital Output Multiplexed on the LVDS/TMDS (LVTM) Interface

Both the M690E and M690T support a dual-channel LVDS 24-bit output through its LVDS interface. However, on the M690E, the interface is enhanced to also support a TMDS/DVI output in place of the LVDS format. An M690E based-system requires a custom video BIOS to configure the enhanced LVDS/TMDS (LVTM) interface to drive out either LVDS or TMDS/DVI signals. The video BIOS is available from AMD. The minimum version number for the LVDS output is 10.55.0.15 and for the TMDS/DVI output is 10.55.0.31. Contact your AMD CSS representative for the latest video BIOS.

A custom video BIOS and proper signal routing from the LVTM interface to a DVI connector are the only requirements for the M690E to support a TMDS/DVI output on the LVTM interface. No other register programming is needed. Users should not attempt to configure the LVTM port by programming the M690E's registers directly.

Features of the TMDS/DVI output include:

- Supports a 30-bit dual-link DVI interface.
- 1650 Mbps/channel with 165MHz pixel clock rate per link (data rate and clock speed to be qualified).
- Supports industry standard EVA-861B video modes including 480p, 720p, and 1080i. For a full list of currently supported modes, contact your AMD CSS representative.

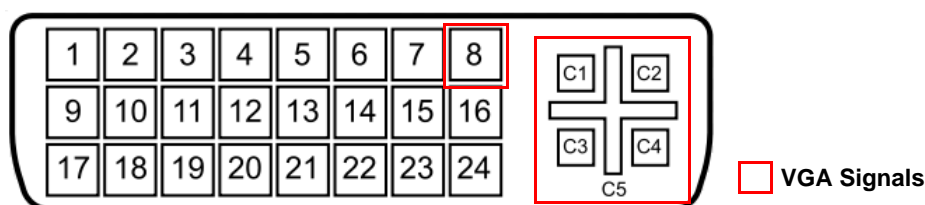


**Figure B-3 M690E LVTM Interface**

Notice that the M690E, like the M690T, can also provide a TMDS/DVI via its TMDS interface that is multiplexed with its PCI Express graphics link. As a result, the M690E can provide two single-link DVI-D outputs using its two on-chip integrated TMDS transmitters—one through the LVTM interface, and the other through the TMDS interface multiplexed with the PCI-E graphics interface.

### B.3 DVI-I Support

The M690E has the capability of driving both digital and analog outputs simultaneously to a DVI-I connector. This is accomplished by routing the RED, GREEN, BLUE, DACHSYN, DACVSYN, and AVSSN signals from the M690E's CRT output (see [Figure B-2, "M690T and M690E Analog Display Output Signals"](#)) to the DVI-I connector's C1(R), C2(G), C3(B), C4(HS), C5(GND), and Pin 8 (VS) signals (see [Figure B-4, "Pins for Analog Output on the DVI-I Connector,"](#) below).



**Figure B-4 Pins for Analog Output on the DVI-I Connector**

For the single-link DVI output portion of the DVI-I connector, AMD recommends using the M690E's LVTM interface to provide the DVI output and routing these digital signals (see [Figure B-3, "M690E LVTM Interface"](#)) to the appropriate inputs on the DVI-I connector. The video BIOS must be configured so that the M690E drives out DVI/TMDS from its LVTM interface. Display modes supported include desktop resolutions such as 800x600, 1024x768, 1152x864, 1280x1024, and 1600x1200 at 16bpp or 32bpp, with 60Hz or 75Hz screen refresh rate.

Creating a DVI-I configuration using the DAC signals (RED, GREEN, BLUE, DACHSYN, etc.) plus the TMDS output multiplexed on the PCI-E graphics links is supposed to work as well, but the configuration is not recommended since it cannot be validated using any of AMD's current internal reference boards.

### B.4 HDMI

The M690E has an integrated controller that allows support for a single-link HDMI (video and audio) transmission on the

LVTM interface. For details on HDMI audio support, please refer to [section 1.3.11, “DVI/HDMI,” on page 1-5](#). Also, like the M690T, the M690E’s TMDS interface that is multiplexed on its PCI-E graphics lanes can also enable HDMI (single-link only).

**Note:** The TMDS interface multiplexed on the PCI-E graphics lanes cannot enable HDMI when the LVTM interface is supporting HDMI, and vice versa.

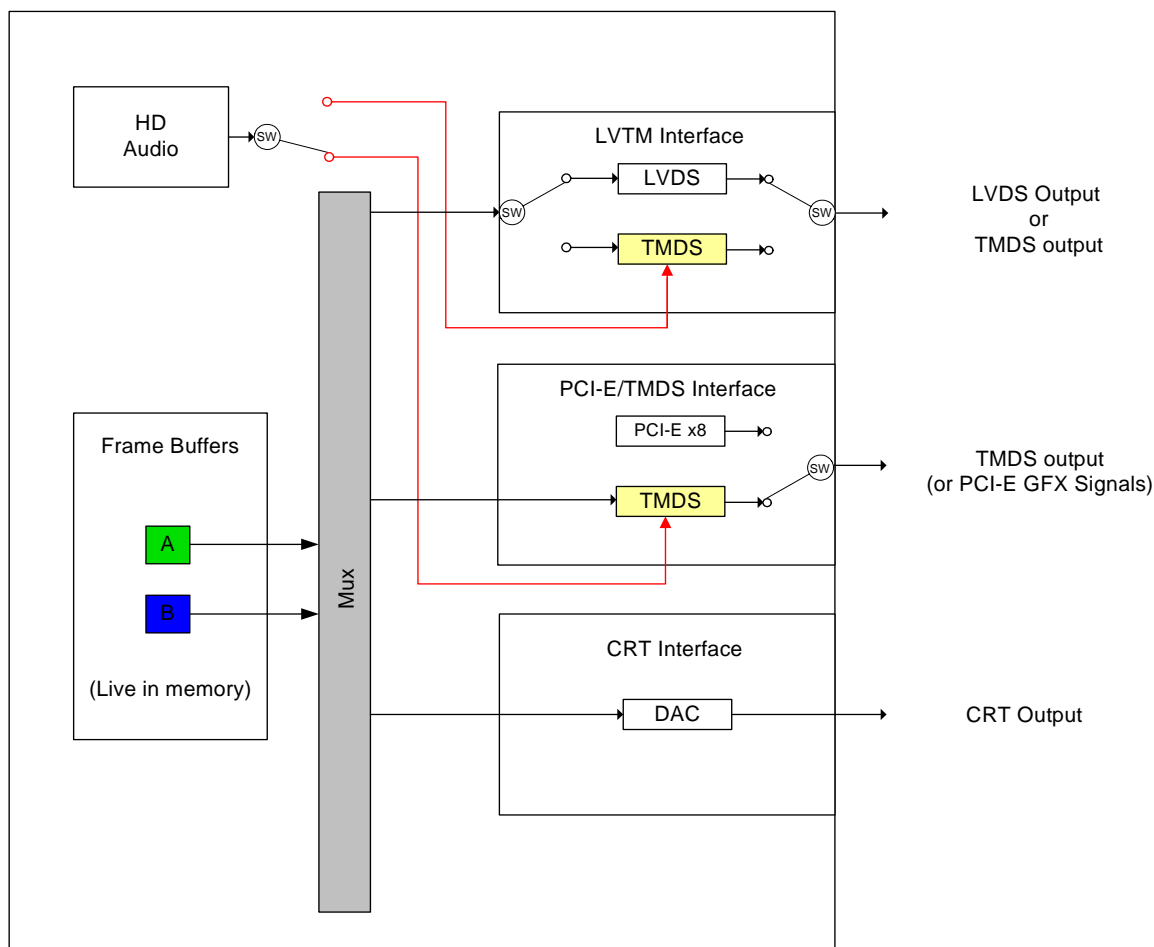
## B.5 HDCP

The M690E supports HDCP on data streams for single-link transmission, with on-chip key storage. It is available either on the DVI/HDMI data stream driven by the LVTM interface or on the data stream driven by the TMDS interface multiplexed on the PCI-E graphics lanes, but both digital outputs cannot be HDCP protected simultaneously.

**Note:** HDCP content protection is only available to licensed buyers of the technology and can only be enabled when connected to an HDCP-capable receiver.

## B.6 M690E Display Options

The display options possible with the M690E are summarized in [Figure B-5](#) below.



**Notes:**

1. Each switch represents 2 possible configuration choices.
2. Each frame buffer output can be routed through the mux to any of the outputs.
3. Each frame buffer has its own resolution, color depth, and refresh rate.
4. TMDS alone is in DVI-D format, and TMDS+Audio is in HDMI format.
5. M690E offers dual DVI by utilizing both TMDS outputs from the LVTM interface and the TMDS interface multiplexed on the PCI-E graphics lanes.

Figure B-5 M690E Display Options

## B.7 The LVTM Interface in TMDS Mode

### B.7.1 Pin Descriptions

When the M690E's LVTM Interface is configured to TMDS mode via the video BIOS, the pins take on the functions as described in [Table B-3](#) below. For operation in LVDS mode, please refer to pin descriptions given in [section 3.8, "LVDS Interface \(24 Bits\)," on page 3- 8](#).

Table B-3 M690E's LVTM Interface in TMDS Mode

Pin Name	TMDS Functional Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
TXOUT_L0N	TX0M	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 0 (-)
TXOUT_L0P	TX0P	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 0 (+)
TXOUT_L1N	TX1M	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 1 (-)
TXOUT_L1P	TX1P	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 1 (+)
TXOUT_L2N	TX2M	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 2 (-)
TXOUT_L2P	TX2P	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 2 (+)
TXOUT_L3N	TX3M	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 3 (-). The channel is only used in DVI dual-link mode and is not used for HDMI support. NC if unused.
TXOUT_L3P	TX3P	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 3 (+). The channel is only used in DVI dual-link mode and is not used for HDMI support. NC if unused.
TXOUT_U0N	TX4M	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 4 (-). The channel is only used in DVI dual-link mode and is not used for HDMI support. NC if unused.
TXOUT_U0P	TX4P	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 4 (+) The channel is only used in DVI dual-link mode and is not used for HDMI support. NC if unused.
TXOUT_U1N	TX5M	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 5 (-). The channel is only used in DVI dual-link mode and is not used for HDMI support. NC if unused.
TXOUT_U1P	TX5P	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS data channel 5 (+). The channel is only used in DVI dual-link mode and is not used for HDMI support. NC if unused.
TXOUT_U2N	–	O	LVDDR33 LVDDR18D	VSSLT	None	Unused. NC.
TXOUT_U2P	–	O	LVDDR33 LVDDR18D	VSSLT	None	Unused. NC.
TXOUT_U3N	–	O	LVDDR33 LVDDR18D	VSSLT	None	Unused. NC.
TXOUT_U3P	–	O	LVDDR33 LVDDR18D	VSSLT	None	Unused. NC.
TXCLK_LN	TXCM	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS clock channel (-)
TXCLK_LP	TXCP	O	LVDDR33 LVDDR18D	VSSLT	None	TMDS clock channel (+)

**Table B-3 M690E's LVTM Interface in TMDS Mode (Continued)**

Pin Name	TMDS Functional Name	Type	Power Domain	Ground Domain	Integrated Termination	Functional Description
TXCLK_UN	–	O	LVDDR33 LVDDR18D	VSSLT	None	Unused. NC.
TXCLK_UP	–	O	LVDDR33 LVDDR18D	VSSLT	None	Unused. NC.

## B.7.2 Data Ordering and Signal Mapping

Refer to [section 2.4.1, “DVI/HDMI Data Transmission Order and Signal Mapping,” on page 2- 9](#) for the data ordering and signal mapping for the TMDS/DVI signal output from the LVTM interface on the M690E.

## B.7.3 Electrical Characteristics

**Table B-4 DC Characteristics for the LVTM Interface in TMDS Mode**

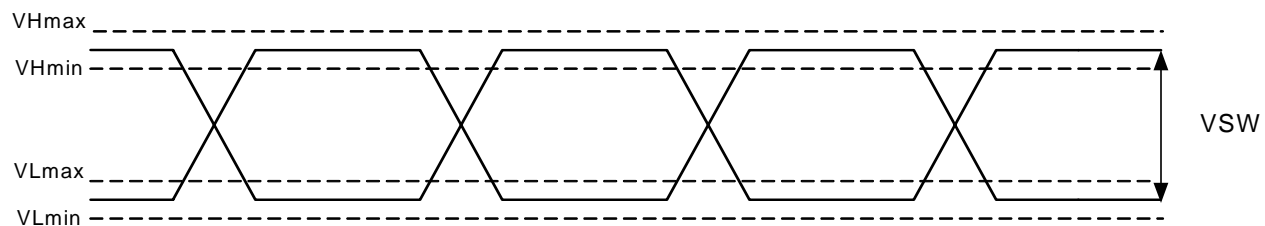
Symbol	Parameter	Min	Typical	Max	Unit	Note
VCM	Common-mode Voltage on Signal Pair	-0.5	–	4.0	V	
VH	Single-ended High Level Output Voltage	AVCC - 10	–	AVCC + 10	mV	1
VL	Single-ended Low Level Output Voltage	AVCC - 600	–	AVCC - 400	mV	1
VSW	Single-ended Output Swing	400	–	600	mV	
VOS	Differential Output Overshoot (Ringing)	–	–	15%*2VSW	–	
VUS	Differential Output Undershoot (Ringing)	–	–	25%*2VSW	–	
IDDLP	Average Supply Current at LPVDD	–	20.0	–	mA	2
IDDLV	Average Supply Current at LVDDR18D and LVDDR33	–	100.0	–	mA	2
IPDLP	Power Down Current at LPVDD	–	10.0	–	μA	3
IPDLV	Power Down Current at LVDDR18D and LVDDR33	–	10.0	–	μA	3

**Notes:**

- 1 AVCC stands for the termination supply voltage of the receiver, which is 3.3V +/- 5%.
- 2 Measured under typical conditions, at minimum differential clock frequency and maximum DVI/HDMI PLL VOC frequency.
- 3 Measured under typical conditions, based on typical leakage values.
- 4 Figure B-6 below illustrates some of the DC Characteristics of the LVTM interface in TMDS mode.



### Single-ended Waveforms



### Differential Waveform

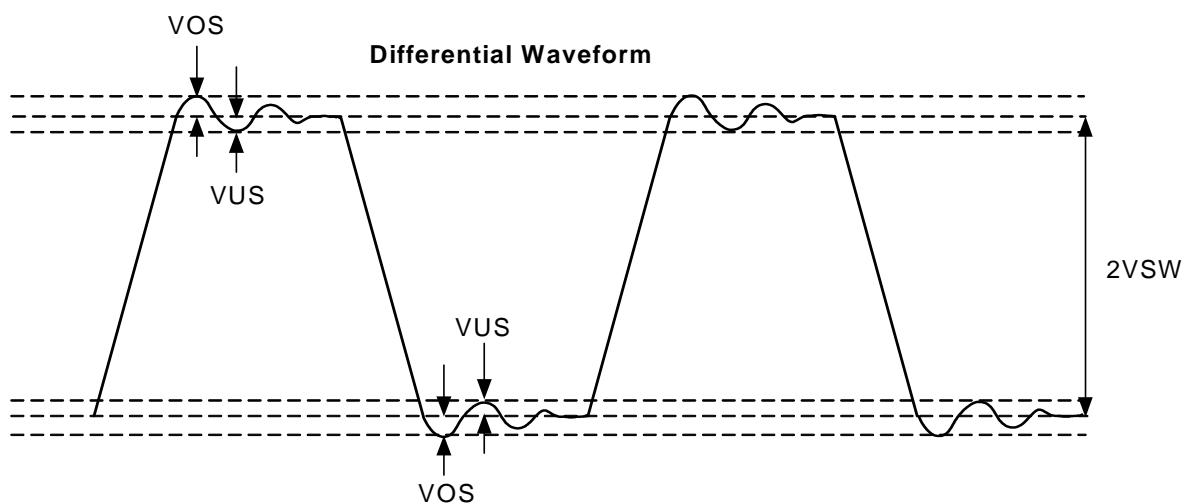


Figure B-6 DC Characteristics of the LVTM Interface in TMDS Mode

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# Appendix C

## *Revision History*

### **Rev 3.01 (February 2007)**

- First release of the RS690T-only version of the databook.
- Updated Section 1.3.11, “DVI/HDMI”: Qualified that HDCP support is for single-link transmission only; revised audio support statement.
- Updated Table 3-3, “1 x 16 Lane PCI Express Interface for External Graphics”: Corrected pin type of GFX\_REFCLKP/N to input only.
- Updated Table 3-4, “1 x 4 Lane A-Link Express II Interface for Southbridge”: Corrected pin type of SB\_CLKP/N to input only.
- Updated Table 3-12, “Miscellaneous Pins”: Updated description for BMREQ#.
- Updated Table 5-9, “RS690T Thermal Limits”: Revised Operating Case Temperature to 0°C minimum and 95°C maximum.

### **Rev 3.02 (April 2007)**

- Added legal note on Macrovision in Section 1.3.9, “Multiple Display Features.”
- Added Table 5-3, “DC Characteristics for 1.8V TTL Signals.”

### **Rev 3.03 (April 2007)**

- Updated legal notes on Macrovision and moved them to the legal notice page at the beginning of the book.

### **Rev 3.04 (June 2007)**

- Changed references to the IGP to M690T.
- Updated Section 1.3.9, “Multiple Display Features”: Revised list of dual-display configurations.

### **Rev 3.05 (Oct 2007)**

- Added information on the M690E (Appendix B, “AMD”).
- Updated branding diagrams for ASIC revision A12 (Section 1.7.2, “Branding Diagrams for ASIC Revision A12 and After”).
- Added support for DirectX VA 2.0 (SD contents only) (Section 1.3.8, “Motion Video Acceleration Features”).
- Corrected the registers by which the LCD panel power up/down timing is programmed (Section 4.8, “LCD Panel Power Up/Down Timing”).
- Removed support for ACPI S1 state (Section 1.3.12, “Power Management Features” and Section 6.1, “ACPI Power Management Implementation”).
- Updated the solder reflow profile (Section 5.3.3.2, “Reflow Profile”).

### **Rev 3.06 (Feb 2008)**

- Added back support for ACPI S1 state Section 1.3.12, “Power Management Features” and Section 6.1, “ACPI Power Management Implementation”).
- Clarified on the maximum resolutions supported by different display interfaces (Section 1.3.9, “Multiple Display Features” and Section 1.3.11, “DVI/HDMI”).
- Corrected register names in the pin descriptions for LVDS\_BLON (Section 3.8, “LVDS Interface (24 Bits”).

- Corrected timing data for LCD pannel power up/down (Section 4.8, “LCD Panel Power Up/Down Timing”).
- Updated Table B-2, “M690T/E Analog TV and VGA/CRT Support Differences.”
- Corrected signal mapping for the LVTM interface of RS690E in TMDS mode (Figure B-3, “M690E LVTM Interface”).